DETAILED REPORTS OF SUBORDINATE OFFICERS OF THE DEPARTMENT OF AGRICULTURE, MADRAS, FOR 1941–1942.

DETAILED ADMINISTRATION REPORT OF THE GOVERNMENT AGRICULTURAL CHEMIST, COIMBATORE, FOR THE YEAR 1941-42 (FASLI).

I submit herewith the detailed report of work in the Government Agricultural Chemist's section during the year 1941-42.

I was in charge of the section throughout the year. The work of the section is reported on under three major heads: I. General including analytical and advisory work; II. Teaching and III. Research on problems on soil science, manuring, plant and animal nutrition, microbiology and agricultural industries.

I.—GENERAL.

Meteorology.—Records of the climatological conditions at 8·00 hours Indian standard time were recorded daily at the observatory at the Agricultural Research Institute.

The table below gives a summary of observations recorded at the Agricultural Research Institute for the year 1941-42 (April 1941—March 1942).

COMMONWEALTH MYCOLOGICAL INSTITUTE 17 DEC 1953

TABLE I.

Year and months.	Temperature.						Relative humidity.			Rainfall.				Wind velocity.		
	Absolute maximum in shade.	Absolute minimum in shade.	Mean maximum in shade.	Departure from normal.	Mean minimum in shade.	Departure from normal.	For the month at eight hours.	Mean for the month.	Departure from normal.	Actual for the month.	Mean for the month.	Departure from normal.	Number of rainy days.	Average for the month.	Mean.	Departure from normal.
	oF	oF	oF	oF	oF	oF	PER-CENT.	PER-CENT.	PER-CENT.	INCHES.	INCHES.	INCHES.		M.P.H.	M.P.H.	M.P.H.
(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
1941—																
April	99·5	70·8	96·6	+ 1·0	75·0	+ 1·9	68·7	71·1	— 2·4	1·65	1·88	— 0·23	2	1·2	2·6	— 1·4
May	101·4	70·0	95·3	+ 0·3	75·6	+ 1·6	67·6	70·2	— 2·6	3·15	2·60	+ 0·55	3	1·9	3·7	— 1·8
June	92·0	67.8	87·5	— 1·5	73·7	+ 0·6	68·3	69·5	— 1·2	6·56	1·48	+ 5·08	2	4·7	7·4	— 2·7
July	91·6	68·7	87·5	+ 1·0	71·7	— 0·6	73·0	71·9	+ 1·1	1·27	2·08	— 0·81	5	2·7	8·6	— 5·9
August	91·5	69·5	87·6	+ 0·7	73·0	+ 1·9	72·5	74·0	— 1·5	2·49	1·19	+ 1·30	7	4·2	7·0	— 2·8
September	91·8	69·5	88·5	— 1·0	71·8	+ 1·3	78·0	73·5	+ 4·5	2·58	1·79	+ 0·79	6	2·2	5·3	— 3·1
October	92·7	67·8	85·1	— 2·4	70·8	+ 0·4	75·5	79·9	— 4·4	2·88	5·70	— 2·82	5	1·3	2·8	— 1·5
November	90·3	61·3	85.0	+ 0·5	70·3	+ 1·8	83·8	80·6	+ 3·2	6·00	4·80	+ 1·20	8	1·1	2·2	— 1·1
December	90·0	56·4	84·5	+ 0·7	64·6	— 0·5	79·9	78·8	+ 1·1	1·92	1·49	+ 0·43	5	1·2	3·0	— 1·8
1942—																
January	88·2	58·2	85·5	— 0·4	63·5	— 0·7	75·4	76·2	— 0·8	..	0·70	— 0·70	..	2·0	3·0	— 1·0
February	94·5	58·3	99·2	— 0·3	67·2	+ 1·4	73·7	71·9	+ 1·8	..	0·52	— 0·52	..	2·3	2·8	— 0·5
March	100·4	61·3	95·8	+ 1·0	67·7	— 2·0	64·7	69·7	— 5·0	..	0·80	— 0·80	..	2·2	2·7	— 0·5
								Total ..		28·50	25·03	+ 3·47				

The rainfall during the year was in slight excess over normal, being 28·50 inches against a normal of 25·03 inches. The distribution was also fairly normal, but with a very large excess for the month of June 1941 and a large defect in October 1941. The pre-monsoon rainfall during May was in slight excess due to unusual thunderstorm activity and early arrival of the monsoon. The rainfall during June was concentrated during the closing days of the month with a record fall of 5·75 inches for the period ending 8 a.m. on 9th June during the passage of a depression across the West Coast.

Temperatures were generally above normal during the month of April and May and nearly normal for the rest of the year. Other climatic elements were nearly normal.

On the whole the year was one of fairly normal distribution of rainfall.

Analytical and advisory.—This branch of work which forms an important part of the work of the section continued its activity during the year. This branch deals with the analysis of samples of soils, manures, feeding stuffs, waters for irrigation and other agricultural products sent for analysis and advice from ryots and other private parties, members of the United Planters' Association of South India, members of the Agricultural department and other Government departments in addition to samples received for analysis in the course of some of the research activities of the section.

Table below gives details of the number of samples received and source of the samples for the period April 1941 till the end of June 1942 :—

TABLE II.

Particulars.	Research.	Agricultural department.	Other Government departments.	Ryots and private parties.	U.P.A.S.I.	Total.
Soils	91	152	34	19	7	303
Manures and composts.	5	116	..	8	35	164
Water	1	19	182	1	..	203
Foods and fodders ..	184	82	86	..	..	352
Cane juices ..	..	280	..	..	..	280
Miscellaneous ..	249	170	8	1	1	429
Total ..	530	819	310	29	43	1,731

A total of 1,731 samples were received and dealt with as in statement above against a total of 2,042 last year. A sum of Rs. 572 was received during the year as analytical fees, consisting of Rs. 265 from members of the United Planters' Association of South, India and Rs. 307 from bona fide ryots and other private parties. As in previous years the section

in addition to carrying out analysis of agricultural products, and sending reports of a routine nature dealt with numerous enquiries for advice upon matters connected with soils, manures, irrigation waters, cattle and human foods from officers of the Agricultural department, and also of the other Government departments. The above totals of samples analysed do not include a total of 5,026 samples consisting of cane juices, rabs and molasses analysed and reported on by the Chemical Assistant at the Agricultural Research Station, Anakapalle, in connexion with the research activities of that station.

Of the samples received and analysed, the following paragraphs give a resume of the more important and interesting samples dealt with and analytical data for the same :—

(1) A sample of horsedung manure was analysed for the Agricultural Demonstrator, Nilakottai. As will be seen from the analytical data given below, the sample was a good one and compares very favourably with a sample of farm-yard manure obtained from the same locality. The horsedung is richer in its phosphoric acid content while the farm-yard manure contains greater amounts of potash. Their nitrogen and humus contents are about the same.

Heads of analysis.	Horsedung manure. Lab. No. 3/1941-42.		Farm-yard manure. Lab. No. 7/1941-42.	
	As received.	On dry basis.	As received.	On dry basis.
	PER CENT.	PER CENT.	PER CENT.	PER CENT.
Moisture	26·67	..	21·02	..
Loss on ignition	21·21	28·93	27·33	34·60
Insoluble mineral matter	36·02	49·12	41·99	53·11
Nitrogen N	0·87	1·19	0·84	1·07
Potash (K_2O)	0·89	1·21	1·28	1·61
Phosphoric acid (P_2O_5)	0·94	1·29	0·66	0·83
Humus	6·70	9·14	6·79	8·60

(2) Two samples of bonemeal were received from A.S.T.F. Rodriguez & Co., dealers in manures: One of them was from their Katpadi Manure Works in the North Arcot district and the other one from their Kadambur Manure Works in the Tirunelveli district. Both the samples were of good quality and have analysed as follows :—

Heads of analysis.	Bonemeal.	
	Katpadi, North Arcot district. Lab. No. 133/41-42.	Kadambur, Tirunelveli district. Lab. No. 955/41-42.
	PER CENT.	PER CENT.
Moisture	5·70	5·44
Loss on ignition ..	37·41	24·86
Insoluble mineral matter ..	1·60	0·68
Nitrogen N.	4·61	3·65
Phosphoric acid (P_2O_5) ..	24·62	26·75

The Katpadi product contained 1·26 per cent more of nitrogen but 2·13 per cent less of phosphoric acid than the Kadambur product.

(3) At the instance of the Millets Specialist and Geneticist, a sample of grass whose botanical name is *Cyanodon-plactostachyum*, Pilger was analysed for its feeding and minerals values with the following results :—

Heads of analysis.	Sample of grass. Lab. No. 1225/40–41.	Heads of analysis.	Sample of grass. Lab. No. 1225/40–41.
	PER CENT.		PER CENT.
Moisture	6·01	Insoluble mineral matter.	7·00
Ash	12·63	Phosphoric acid (P_2O_5).	0·50
Proteins	10·16	Lime (CaO) ..	0·87
Ether extractives ..	1·56	Hydrocyanic acid (HCN).	0·0065
Crude fibre	29·57		
Carbohydrates (by difference).	40·07		
Total ..	100·00		

The sample of grass possessed good feeding value. It was tested for its hydrocyanic acid content also which is low enough to permit use of this grass as a fodder grass.

(4) A sample of tobacco leaf mid-ribs was analysed for the District Agricultural Officer, Guntur, for its manurial value and it had the following composition :—

Heads of analysis.	Tobacco leaf mid-ribs. Lab. No. 254/41–42.
	PER CENT.
Moisture	9·42
Loss on ignition	68·52
Insoluble mineral matter	0·25
Nitrogen N	1·63
Potash (K_2O)	7·46
Phosphoric acid (P_2O_5)	0·56

The sample contained fair amounts of nitrogen but was particularly rich in its potash content. Samples of tobacco ashes have been analysed and their potash content has been up to 30 per cent as K_2O. If sufficient quantities of tobacco ashes are made available they are better utilized for replenishing the potash content of soils. Tobacco stem and refuse is a valuable source of potash and should be investigated further.

(5) A sample of groundnut cake called commercially "Hydraulic groundnut cake" was received from Messrs. Stanes & Co., Coimbatore, at the instance of the Oil-seeds Specialist, Coimbatore. The firm claimed that this hydraulic pressed cake

gave a higher percentage of nitrogen than the other varieties and that it had a nitrogen content of up to 8·5 per cent. This firm reported that the sample of cake obtained by the ordinary chekku expression gave 7·0 per cent of nitrogen and the expeller cake 7·5 per cent to 8·0 per cent nitrogen while this hydraulic cake would give 8·0 per cent to 8·5 per cent nitrogen. The sample, however, gave on analysis only 7·7 per cent of nitrogen, thus falling by 0·3 per cent below the minimum guarantee given by the firm of suppliers. The analytical data are given below :—

Heads of analysis.	Hydraulic pressed groundnut cake. Lab. No. 265/41-42.
	PER CENT
Moisture	8.81
Loss on ignition	86·40
Insoluble mineral matter	0·61
Nitrogen N	7·70
Phosphoric acid (P_2O_5)	1·43

(6) The Manager, Sivalokam Estate, Marthandam, Travancore, sent a sample of rubber leaves for being examined for their mineral composition. The sample analysed as follows on moisture free basis. The material when received was dry and contained only 9·5 per cent of water.

Heads of analysis.	Rubber leaves. Lab. No. 314/41-42.
	PER CENT
Nitrogen N	3.84
Potash (K_2O)	1.41
Phosphoric acid (P_2O_5)	0.61
Lime (C_aO)	0.91

The sample of rubber leaves contained good amounts of nitrogen and fair amounts of potash.

(7) At the request of the District Agricultural Officer, Ramnad, a sample of *Acacia* pods was analysed for its feeding value. The analytical data given below would indicate that the seed is rich in its protein contents and that lime is present in them in fair amounts. The seed has a fairly good nutritive value and can be used for cattle feeding.

Heads of analysis.	*Acacia* pods. Lab. No. 445/41-42.
	PER CENT
Moisture	9·23
Ash	7·78
Proteins	14·33
Ether extractives	1·64
Crude fibre	15·35
Carbohydrates (by difference)	51·67
Total	100·00
Phosphoric acid (P_2O_5)	0·41
Lime (C_aO)	1·29

(8) A sample of urine earth, received from the Agricultural Demonstrator, Kumbakonam, and reported to have been collected from a few well-maintained dry earth sheds in the village had the following composition. The sample was dry and contained only 11·0 per cent of water.

Heads of analysis.	Urine earth. Lab. No. 947/41-42.	
	As received. PER CENT.	On dry basis. PER CENT.
Moisture	11·02	..
Loss on ignition	2·51	2·82
Insoluble mineral matter ..	82·81	93·07
Nitrogen N ..	0·07	0·08
Potash (K_2O)	0·45	0·51
Phosphoric acid (P_2O_5) ..	0·13	0·14

The sample of urine earth contained only small amounts of the essential plant food ingredients as can be expected. It was reported by the demonstrator that this earth was recommended as a top dressing to standing paddy crops.

(9) Samples of pollen collected from cholam and maize were analysed for the Government Entomologist who desired to have a relative idea of their feeding values connected with his study on the nutrition of bees. From the data presented below, it will be seen that both the pollen samples contain fair amounts of food materials and are almost similar in composition.

Heads of analysis.	Pollen. Cholam. Lab. No. 154/41-42, PER CENT	Maize. Lab. No. 294/41-42. PER CENT.
Moisture	46·34	52·88
Ash	1·86	1·38
Proteins	11·57	10·00
Ether extractives ..	1·35	2·24
Crude fibre.	3·74	2·99
Carbohydrates (by difference)	35·14	30·51

(10) The District Agricultural Officer, Coimbatore, sent two samples of water drawn from wells in a village in the Coimbatore taluk for analysis. One of them was reported to be very good for tobacco growth and the other one not so good. On analysis it was found that the sample which was reported to be good for tobacco contained higher amounts of potash though the total solids content was high. There was no difference in their pH values.

Heads of analysis.	Water samples. Parts per 100,000.	
	Lab. No. 948/41–42. Not good for tobacco.	Lab. No. 949/41–42. Very good for tobacco.
	PER CENT.	PER CENT.
Total solids ..	78·4	121·2
Potash (K_2O) ..	2·6	7·1
P_H	7·75	7·79

Although the sample (Lab. No. 949/41–42) contained more of total solids, the higher amounts of potash presumably contributed to better growth of tobacco.

(11) The Paddy Specialist, Coimbatore, sent a number of samples of raw rices, milled and hand-pounded, obtained from the various markets for being examined for their chemical composition with a view to ascertain their relative food values. The analytical data are presented below. It will be noticed that the milled samples have all lost part of their nutrients with the exception of the two varieties, namely, Co. 15 (10998) and Co. 16 (11348) which can, therefore, be considered of exceptional quality.

Results of analysis of the different varieties of rice samples, milled and hand-pounded received from the Paddy Specialist.

(Expressed on moisture-free basis in percentages.)

Variety of rice.	Process of preparation.	Laboratory number of 1941-42.	Ash.	Protein.	Fat.	Fibre.	Carbo-hydrates.	Lime (CaO).	Phosphoric acid (P_2O_5).	Nutritive ratio.	Remarks Moisture in the sample.
		PER CENT.	PER CENT.	PER CENT.	PER CENT.	PER CENT.	PER CENT.	PER CENT.	PER CENT.	PER CENT.	PER CENT.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Molagolukalu ..	.. Milled	1,533	0·79	8·11	0·77	0·57	89·76	0·04	0·48	11·3	11·48
G.E.B. 24 ..	.. Milled	1,534	0·74	7·70	0·47	0·68	90·41	0·03	0·40	11·9	10·91
	.. Hand-pounded	1,535	1·47	7·64	1·92	1·45	87·52	0·05	0·73	12·0	10·65
10998 Co. 15 ..	.. Milled	1,536	1·06	6·65	0·77	0·91	90·61	0·04	0·42	13·9	11·43
	.. Hand-pounded	1,537	1·35	6·51	1·53	1·29	89·32	0·02	0·62	14·3	11·20
Atragada ..	.. Milled	1,538	1·40	6·54	0·53	0·10	91·43	0·03	0·36	14·2	12·17
	.. Hand-pounded	1,539	1·77	6·86	2·47	0·62	88·28	0·02	0·84	13·7	12·14
Delhi Bhogam	.. Milled	1,540	1·19	9·67	0·64	0·26	88·24	0·02	0·39	9·3	10·46
	.. Hand-pounded	1,541	1·33	7·42	2·49	0·55	88·21	0·03	0·93	12·6	11·42
11348 Co. 16	.. Milled	1,542	1·27	8·16	2·12	0 60	87·85	0·03	0·82	11·3	11·40
	.. Hand-pounded	1,543	1·34	8·22	1·91	0·90	87·63	0·03	0·72	11·2	11·30
Krishnakatukulu	.. Milled	1,578	0·97	7·54	0·57	0·27	90·65	0·04	0·41	12·2	11·09
	.. Hand-pounded	1,579	1·06	6·77	1·12	0·35	90·70	0·03	0·57	13·8	10·61
White sirumani	.. Milled	1,580	0·72	7·45	0·87	0·27	90·69	0·04	0·38	12·4	11·99
	.. Hand-pounded	1,581	1·09	7·20	1·35	0·45	89·91	0·03	0·53	12·9	10·88

Co. 15 (Jada molagolukalu) or 10998 is a hybrid culture isolated from a cross between G.E.B 24, a comparatively resistant variety to blast and Korangu samba of Tanjore which is susceptible but a very heavy yielder. Co. 16 (Bontha molagolukalu) or 11348 is another hybrid culture isolated from the same cross as that of Co. 15 and this is also highly resistant to blast. It is learnt from the Paddy Specialist that both these strains are intended to replace Nellore samba of Nellore and Central districts and Korangu samba of Tanjore. Their yields are reported to be good when compared to Nellore molagolukalu. The chemical analysis also indicates that their quality is equally good. The withdrawal of the local molagolukalu of Nellore which is reported to be highly susceptible to blast may well be recommended.

(12) It is of interest to report the analysis of a batch of four samples of commonly used green leaf manures analysed for the Senior Lecturer in Agriculture, Coimbatore.

Heads of analysis	Lab. No. 260. Cassia auriculata	Lab. No. 261. Cassia siamia	Lab. No. 262. Pongamia glabra	Lab. No. 263. Sesbania speciosa
	PER CENT.	PER CENT.	PER CENT.	PER CENT.
(i) *Oven dry basis*—				
Loss on ignition	92·15	92·37	92·19	91.75
Insolubles	0·85	0·22	0·65	0·16
Solubles (by difference) ..	7·00	7·41	7·16	8·09
Total ..	100·00	100·00	100·00	100·00
Nitrogen	2·36	2·24	3·31	2·71
Phosphoric acid (P_2O_5) ..	0·64	0·40	0·44	0·53
Potash (K_2O)	2·48	1·31	2·39	2·21
(ii) *Original Moisture basis*—				
Moisture	63·34	60·46	65·12	74·91
Loss on ignition ..	33·78	36·52	32·16	22·96
Insolubles	0·31	0·09	0·23	0·04
Solubles (by difference) ..	2·57	2·93	2·49	2·09
Total ..	100·00	100·00	100·00	100·00
Nitrogen	1·05	0·88	1·16	0.68
Phosphoric acid (P_2O_5) ..	0·23	0·16	0·15	0·13
Potash (K_2O)	0·91	0·52	0·83	0·60

The samples are rich in all the manurial ingredients, *Pongamia glabra* being the best of the group confirming its superiority as green leaf manure especially for paddy which is in agreement with field experience.

II.—TEACHING.

Degree course of the Madras University.—The following table gives details of lecture and practical classes conducted for the students of the B.Sc. (Ag.) degree course during the academic year 1941-42 :—

Class.	Lecture classes.	Practical classes.
B.Sc. (Ag.) I	56	56
B.Sc. (Ag.) II	54	25
B.Sc. (Ag.) III	117	89
Total ..	227	170

Short course of the Agricultural College—(a) Malt-making.—A short course of lectures and practical demonstrations on the making of malt from indigenous cereals was conducted during the month of September 1941. Nine students attended the course which consisted of eight lectures and practical demonstrations to enable the students to gain a knowledge of the theoretical and practical aspect of malt-making.

(*b*) *Jaggery-making.*—This course was conducted during the month of February 1942 and was attended by eight students of the short course. Lectures and demonstrations in the making of jaggery from cane and palm juices were conducted to give the students an opportunity to gain a practical knowledge of jaggery-making and the principles involved therein.

III.—RESEARCH.

Reclamation of alkaline lands under dry conditions.—In the previous reports of this section, details have been given of work on the reclamation of alkaline lands under irrigation from canals (as under the High Level channel) and from wells (as at the Central Farm, Coimbatore). In the former instance it has been shown that treatment with gypsum or sulphur and with the provision of drainage facilities, made for a marked improvement in the conversion of the soil provided a copious supply of irrigation water was available. In the case of the garden lands at Coimbatore, ameliorative measures were conditioned by a supply of water of good quality, which if not available resulted in no good results. The case of dry lands growing rainfed crops and depending on natural rainfall only is very different.

No details are available in literature as to the treatment of alkaline lands under rainfed or dry conditions. During the year under report a case of a dry area in the Guntur district, reported to be rendered alkaline and unfit for growing of crops was referred for investigation. The lands in question were at the village of Peddapalakalur near Guntur town. The cultivator of the lands, Rao Bahadur K. M. Krishna Rao, stated that his lands had

become progressively infertile and requested the department to undertake a study of the lands, which he claimed represented a large area in the vicinity. This area was personally visited by me in the month of August 1941 and the investigation was started by first taking samples of soil of the affected area. Detailed report has been submitted on the subject to the Director of Agriculture; for the purpose of this report the main findings may be summarised as follows:—

(i) The area is liable to inundation from a water course during sudden heavy downpour of rain in the upper reaches of the water course traversing the area.

(ii) The analysis of the soils indicates a serious condition of accumulation of sodium salts, coupled with a high degree of alkalization of even the lower layers.

(iii) The sub-soil water table was high, being 5'6" below the surface.

(iv) No facilities were available for natural drainage since the lands were flat with little fall away from the water course.

Such a condition of the soils of the area was considered very serious with little hope of reclamation by simple means. An experiment was however designed and laid out to study conditions with a system of artificial drainage and heavy application of cattle manure. The cropping is expected to be started during the next cropping season depending on favourable seasonal conditions.

Study of soils suitable for the cultivation of Virginia tobacco.—The problem of the quality in Virginia tobacco as linked with soil composition has been under study for the last two years. The tobacco growers of the Guntur district are of the opinion that among the many factors responsible for the good colour developed in Virginia tobacco, the soil composition plays an important part. The leaf of the tobacco produced in certain parts of Guntur district finds better favour with buyers than that grown in other parts. The 'Badava' lands (i.e., those liable to inundation from the river) are said to be the best for production of good quality leaf.

Previous work had shown that the high quality in leaf was associated with a low soluble salt content, which might be associated with a low soluble salt content of the soil on which the tobacco was grown. The analysis of the soils on which particular good types of tobacco leaf were grown was completed during the year under report. The soils were collected and sent by the District Agricultural Officer, Guntur, with full details of the locality and type of tobacco grown thereon. The results of analysis of thirty-five soils showed that there was very little relationship between the amounts of total and available plant foods and the development of good colour in tobacco grown thereon. The moisture relationship of the soils would seem to be more important than the chemical composition. The 'Badava' lands (those liable to periodic inundation from the river Kistna) are highly valued for their properties as lands producing good

quality of tobacco. These lands were on analysis for their moisture relations found to be highly retentive. This gives a clue that apart from the low soluble salt contents these soils being of good moisture holding capacity are suitable for the growing of good crops of tobacco. Further studies are in progress on this problem.

Study of the lanka soils of Godavari delta for growing Virginia tobacco. - As has been shown above the 'Badava' soils of Guntur district are specially suitable for growing of Virginia tobacco; it is reasonable to expect that the lanka soils of the Godavari delta are equally, if not better suited for the purpose. As a matter of act the growing of Virginia tobacco on these soils has been steadily extending in recent years. A request from prominent tobacco growers in the Vanapalli Lanka (Kothapeta and Amalapuram taluks) for survey of the area led to a visit by me during the month of August 1941. The results of the enquiry were reported on in a separate report and a series of experiments were laid out at Venapalli and Inavally on ryots' lands to test the quality of tobacco as influenced by manuring. The results of the preliminary survey may be stated as follows :—

(i) The Godavari lankas, areas liable to periodical inundation and not under irrigation by the canal system, are very suitable areas for the cultivation of Virginia tobacco.

(ii) The cultural practices of having a cereal (jonna) followed by tobacco and followed by a two to three years pasture fallow showed that practically no manuring was required, since the periodical floods of the river gave new silt and the pasture fallow made for soil recuperation.

(iii) The conditions for the culture of Virginia tobacco were almost ideal in that area.

(iv) The area could be made to yield more crops by suitable rotation.

Soil samples collected there are under analysis and results are awaited with interest. The experiments laid out there on ryots' lands were unsuccessful owing to an abnormal season of no flooding and of late rains. The experiments will be repeated during the current year.

Fundamental studies on the genesis of the black and red soils of Madras Deccan.—Based on the work on the mineralogical composition of the fine sand components of the respective soil types as reported previously when it was pointed out that the black and red soils were derived from two different types of rocks—one containing soda-lime felspars and hornblende and the other containing orthoclase felspar and mica. Work was in progress on the examination of the clay fraction by chemical methods which revealed further evidence in support of the above thesis. The work done shows that the dominant clay mineral in the black soil

is a montmorillonitic type containing considerable amounts of lattice magnesium, while the red soil clay contained considerably larger amounts of 'free iron'; the amount of SiO_2 in it being of the same order as that of the black soil colloid when allowance is made for the free iron present. The SiO_2/R_2O_3 ratio is however lower than that of the black soil colloid and pointed either to a considerable degree of kaolinization or to extensive replacement of SiO_2 by Al_2O_3 in the clay mineral.

Evidence of definite kaolinization in the red soil colloid was thus wanting and attempts were made during the year to study this aspect of this genesis by the usual dehydration methods.

Samples of clay of the black and red soils were prepared by taking about 2 kilos of each of the two soils and treating them with a solution of sodium chloride till all the exchangeable bases were replaced by sodium. The soils were then washed on a Buchner till free from chloride. The soil mass was then suspended in water and a sufficient quantity of NaOH was added to deflocculate the clay and then shaken for about 24 hours in the first instance. The suspension was then transferred to large beakers and allowed to settle for 24 hours. The sedimentation was continued till most of the clay fraction was removed. The supernatant liquids containing the clay were then mixed and passed through a Sharple's centrifuge running at over 300,000 revolutions per minute. The clay thus obtained was then removed, dried, powdered and used for the experiments.

Dehydration studies were made with air dry samples and as well as with samples dried at 110° C. The samples were weighed out and dehydrated at definite temperatures in a muffle; the temperature being measured with a pyrometer.

The extents of loss at various dehydration temperatures which lay between air-dry state and 1,000° C were determined. The results of these experiments are given in table below;

Results of dehydration of clay samples.

Type of colloid.		Loss in weight expressed as per cent of air dry or oven dry sample. Temperature of dehydration.								Remarks.
		110°.	200°.	350°.	400°.	450°.	500°.	550°.	600°.	>600°.	
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Black soil (Deccan)	1	3·07	..	5·29	5·29	6·14	7·05	8·91	11·13	14·85	Calculated on air dry sample.
	2	3·07	3·98	..	..	6·88	..	..	..	14·85	Do.
	3	3·05	3·99	..	..	5·95	..	..	..	14·90	Do.
	4	..	..	..	..	..	..	..	..	..	Lost.
Red soil (Deccan)	1	5·99	..	9·03	9·82	12·21	14·06	16·65	16·65	16·65	Calculated on air dry sample.
	2	5·99	..	13·60	14·34	15·77	17·05	18·37	18 64	18·64	Do.
	3	5·64	7·33	..	..	8·91	..	..	..	15·23	Do.
	4	5·64	7·41	..	..	12·99	..	..	..	15·30	Do.
Black soil (Deccan)	1	..	1·30	3·42	4·85	..	8·39	..	11·42	12·72	Calculated on sample dried at 110° C.
	2	..	1·11	2·37	4·49	..	6·25	..	11·23	13·76	Do.
Red soil (Deccan)	1	..	0·25	1·49	5·21	..	7·88	..	8·54	8·79	Do.
	2	..	0·91	2·43	7·69	..	9·31	..	10·52	10·52	Do.

The black soil colloids were seen to contain much less of hygroscopic moisture than the red soil colloid—the former containing 3 per cent as against 6 per cent of the latter. This is surprising and points to the clay mineral of the black soil colloid of being a predominantly different one from that of the mont-morillontie. The higher moisture content of the red soil colloid may be due to the higher amounts of colloidal ferric oxide.

At higher temperatures ($\geq 110°$) the loss of moisture from both the types takes place progressively up to 600° C beyond which the red soil colloid loses no more moisture while the black soil colloid differs in this respect from that of the red soil by registering a further loss of moisture beyond 600° C.

The progressive loss of moisture is characteristic of the mont-morillonitic type and of hydrous micas which are probably indicated in both soils.

The loss of moisture in the case of the red soil takes place on the whole at a comparatively lower temperature (300°—450°) than in the case of the black soil which requires a temperature above 450° C (450°—650°).

The clay minerals of soils belong in general to one of three family groups.

(*a*) The kaolinite-halloysite group containing a comparatively larger amount of lattice or combined water than of absorbed water which it splits off below 450° C.

(*b*) Bentonitic and beidellite group with more absorbed water than lattice water and splitting the latter type of water at about 550° C.

(*c*) Hydrous micas, pyrophillite and micas which are more like those of group (*b*) and differ from them in that they contain water which is lost only above 600° C.

Both the types of soil colloids black as well as red show a progressive loss of moisture till 550° C resembling groups (*b*) and (*c*). But the red soil colloid loses most of its water *at a lower temperature* showing that it might have undergone some degree of kaolinization.

The further loss of 3 per cent moisture at temperatures above 600° C which the black soil colloids alone show, indicates the presence in them of considerable amounts of minerals of the hydrous mica type –a typical example of which mineral is afforded by the ordovician bentonites investigated by the Aberdeen School of Workers.

Similar studies were made with the coarser fractions obtained by 2, 4 and 6 hour sedimentations of the soil mass left after the removal of clay.

Sufficiently large quantities of black and red soils were subjected to the same kind of preliminary treatment and converted into Na-soils. The soil masses were then suspended in water; the fine sand and the silt fractions were removed and the

finer material left was separated into three fractions with settling velocities of 10 cm./2 hours, 10 cm./4 hours and 10 cm./6 hours respectively. The three separates thus obtained were collected and were separately examined for their behaviour on dehydration and for their chemical composition. The results of these studies are given in statement below :—

Dehydration losses of soil separates.

Description of separates. (1)	Temperature of dehydration. 350 ° C. (2)	650 ° C. (3)	1000 ° (4)
1 Black soil. 10 cm/2 hours. ..	0·79	1·54	5·14
2 Do. 10 cm/4 hours. ..	0·92	7·48	12·11
3 Do. 10 cm/6 hours. ..	3·88	16·17	19·15
4 Red soil. 10 cm/2 hours. ..	0·73	1·15	1·32
5 Do. 10 cm/4 hours. ..	2·42	2·27	2·49
6 Do. 10 cm/6 hours. ..	2·87	3·93	4·12

Analysis of soil separates.

Heads of analysis. (1)	Black soil. 10 cm. 2 hrs. (2)	10 cm. 4 hrs. (3)	10 cm. 6 hrs. (4)	Red soil. 10 cm. 2 hrs. (5)	10 cm. 4 hrs. (6)	10 cm, 6 hrs. (7)
1 Free iron oxide	13·85	39·8	3·18	1·83	8·88	3·33
2 Total silica	63·35	42·52	70·8	69·50	60·45	61·40
3 HF. residue	22·80	17·68	26·0	28·67	30·67	35·27
4 Combined iron oxide ..	2·86	1·87	3·42	2·38	1·19	3·42
5 Combined magnesium.	1·10	1·69	1·48	0·51	0·72	1·50

The coarsest of the three fractions showed a loss of 0·79, 1·54, and 5·14, respectively, at 350 ° 600 and 1,000 ° C in the black soil colloids while the corresponding losses of the red soil colloids were 0·73, 1·15 and 1·32, respectively. The greater loss of moisture above 600 ° C in the black soil fraction is indicative of the bentonitic character of the clay found in those soil formations. Even more pronounced than in the coarsest fraction are the losses of moisture at the higher temperature levels, in the other two fractions. The red soil separates, however, do not show any indication of the type of dehydration losses that its clay shows. All the three fractions lose practically little or no water at all beyond 600 ° C.

The chemical composition of the separates also present some unexpected features particularly with respect to free iron. Unlike as in the case of the clays from the two soils, these fractions showed greater amounts of ' free ' iron in the black soil than in the red. Silica is greater in the red soil fraction. The black soil separates contain consistently more of silicate magnesium. The ' combined ' or ' silicate ' iron is in all cases greater than 1 per cent. It is possible that the presence of finely divided quartz in the red soil fractions is responsible for these abnormalities in their composition, viz., lower iron oxide content and higher silica content. Further work is in progress.

These studies would seem to confirm what has been reported on before that the two soil types, i.e., black and red are two different ones, and are due to differences in their genesis from

parent material, but not because of conditions of formation. The results of further studies will be reported on in due course.

Field experiments—(i) *Old permanent manurials.*—These experimental fields were left as cultivated fallow during the year, owing to the non-availability of water, for irrigation purposes, from the yard well at the Central Farm and will now be abandoned as an experimental block.

(ii) *The new permanent experiments.*—In these experiments, conducted in Field No. 45 at the Central Farm two crops were taken in the year—crop Nos. 27 and 28.

Summer cholam—A.S. 809 yellow—Crop No. 27—was sown on 19th March 1941 and harvested in July 1941. The seed rate adopted was 20 lb. per acre. The results of yields obtained are given in the table below on acre basis. It will be noticed that the western series which receive each season in addition to the artificials applied as per scheme of experiments, 2,000 lbs. of cattle manure, have registered higher yields with the exception of the 'No manure' plots.

The next crop (No. 28) taken from these experiments is cumbu—variety P.T. 367. This was sown on 28th November 1941 and harvested on 13rd March 1942. The seed rate adopted was 10 lb. per acre. The yields obtained are given in table below on acre basis. Here it will be seen that the cattle manure plot has yielded the best in both the series, but as between the two series, the performances are not quite consistent as in the case of the previous crop.

TABLE.

Plot number and Treatment.	Crop No. 27. Summer cholam P.S. 809 yellow. Yield per acre in lb.		Crop No. 28. cumbu A.T. 367. Yield per acre in lb.	
	Grain dry.	Straw dry.	Grain dry.	Straw dry.
(1)	(2)	(3)	(4)	(5)
Eastern series.				
1 No manure ..	2,094	6,053	979	2,616
2 N.	2,142	6,622	1,119	3,189
3 N + K.	2,027	5,511	956	3,147
4 N + P.	2,358	5,757	1,078	2,720
5 N + K + P.	2,337	5,456	909	2,808
6 K + P	1,865	4,054	956	1,981
7 K.	1,736	4,108	851	2,215
8 P.	1,696	4,332	956	2,504
9 Cattle manure	2,176	5,006	1,456	3,273
10 Cattle manure residual	1,392	3,973	874	2,262
Western series.				
11 No manure	1,899	4,857	1,078	2,063
12 N.	2,473	5,694	1,293	3,064
13 N + K.	2,445	5,117	1,119	3,656
14 N + P.	2,675	6,436	1,078	3,484
15 N + K + P.	2,730	5,670	1,189	3,293
16 K + P.	2,237	5,172	1,153	2,878
17 K.	2,311	5,484	1,084	2,872
18 P.	2,000	5,109	1,084	2,849
19 Cattle manure	2,797	6,095	1,410	3,684
20 Cattle manure residual	2,405	5,470	1,165	3,076

Seed-bed manurial experiments.—These experiments were started in the wet lands " B " block in the year 1938 with the object of assessing the usefulness or otherwise of a liberal manuring of paddy in the nurseries themselves and have been in progress for four years now. The fourth-year results are presented below. This year also the results satisfy 'Z' test in respect of the treatments given. This experiment will be continued for one more season. Indications obtained so far would appear to point out the fact that manuring of seed beds has been relatively more economical. Table below gives yields for the year under report :—

TABLE.

Variety Co.1. paddy.

Transplanted on 23rd August 1941.
Harvested on 12th December 1941.

Poor seedings.			Normal.			Heavily manured seedings.		
Plot.	Grain.	Straw.	Plot.	Grain.	Straw.	Plot.	Grain.	Straw.
			No manure plot.					
3	97	84	6	89	95	8	86	84
10	80	61	18	77	80	16	83	79
26	77	76	25	74	62	20	106	107
29	77	81	31	73	92	32	70	74
Total ..	331	302		313	329		345	344
Average ..	83	75·5		78	82		86	86
	2,587	2,240		2,374	2,534		2,294	2,240
	2,133	1,627		2,053	2,133		2,213	2,106
	2,053	2,026		1,973	1,653		2,827	2,854
	2·053	2,160		1,947	2,451		1,867	1,973
Total ..	8,826	7,653		8,347	8,771		9,201	9,173
Average ..	2,206·5	1,913		2,087	2,193		2,300	2,293
			½ *Normal manured plot.*					
5	92	87	9	95	82	2	117	103
11	84	79	15	75	82	13	84	85
22	84	82	21	84	102	27	82	75
33	78	80	35	82	80	28	73	88
Total ..	338	328		336	346		361	351
Average ..	84·5	82		84·0	86·5		90	88
	2,454	2,320		2,533	2,186		3,120	2,746
	2,240	2,106		2,000	2,186		2,240	2,267
	2,240	2,186		2,240	2,720		2,186	2,000
	2,080	2,133		2,186	2,133		2,080	2,347
Total ..	9,014	8,725		8,959	9,225		8,626	9,360
Average ..	2,253	2,186		2239·75	2,306		2156·5	2,340
			Normal manured plots.					
4	103	85	7	93	104	1	129	120
17	109	98	12	87	104	14	87	103
1	1 5	102	23	89	·4	24	77	105
34	91	82	36	85	82	30	87	94
Total ..	408	367		354	374		380	422
Average ..	102	92		88·5	93·5		95	105·5
	2,746	2,267		2,480	2,773		3,441	3,201
	2,926	2,613		2,320	2,773		2,320	2,746
	2,800	2,720		2,874	2,240		2,053	2,800
	2,427	2,186		2,267	2,186		2,320	2,507
Total ..	10,879	9,786		9,441	9,972		10,134	11,254
Average	2,720	2,446·5		2,360	2,493		2553·5	2813·5

Spacing and manurial trials.—This experiment has been in progress at the Central Farm wet lands 'A' and 'B' block since 1939–40. Details of the object, layout and treatments will be found in the annual report for that year. The results of yields presented below relate to the third year of the trials. It is seen that the results satisfy the 'Z' test in general. The indications are that spacing adopted has more marked effect than manures applied. No interaction is noticed between treatments. Heavier application of manures does not help in increasing the yield of plots where wider spacing is adopted. It is now proposed to conclude this experiment.

Combined manuring and spacing experiments A and B block, wet lands Central Farm.

Transplanted on 24th August 1941. Variety GEB. 24.
Harvested on 10th December 1941.

18 inches.			12 inches.			6 inches.		
Plot.	Grain.	Straw.	Plot.	Grain.	Straw.	Plot.	Grain.	Straw.
			70 *lb. Nitrogen.*					
			Yield per plot of 2·8 cents.					
1	93	52	5	90	70	6	103	76
12	49	44	11	70	57	14	88	109
21	65	77	24	79	67	19	92	90
35	82	64	34	69	55	30	94	77
Total ..	292	237		308	249		377	352
Average per plot,	73	59		77	62		94	88
			Yield in lb. per acre.					
	3,321	1,857		3,214	2,500		3,678	2,714
	1,750	1,571		2,500	2,035		3,143	3,893
	2,429	2,750		2,821	2,393		3,285	3,214
	2,928	2,286		2,464	1,964		3,357	2,750
Total ..	10,438	8,464		10,999	8,892		13,463	12,571
Averaga per plot,	2,607	2,116		2,750	2,223		3 366	3,143
			50 *lb. Nitrogen.*					
			Yield per plot of 2·8 cents..					
8	69	54	4	72	54	2	105	108
16	86	60	18	90	60	13	96	69
27	89	65	25	58	61	20	84	63
33	58	65	28	68	83	29	82	68
Tothl ..	302	244		288	258		367	308
Average per plot.	75·5	61·0		72	64·5		92	77
			Yield in lb. per acre.					
	2,464	1,928		2,571	1,928		3,750	3,599
	3,072	2,143		3,214	2,143		3,429	2,469
	3,178	2,321		2,062	2,178		3,000	2,250
	2,071	2,321		2,428	2,964		2,928	2,428
Total ..	10,785	8,713		10,275	9,213		13,107	10,741
Average per plot.	2,696	2,178		2,569	2,303		3,277	2,685

18 inches,			12 inches.			6 inches,		
Plot.	Grain.	Straw.	Plot.	Grain.	Straw.	Plot.	Grain.	Straw.
			30 *lb. Nitrogen.*					
			Yield per plot of 2·8 cents.					
9	55	45	3	74	60	7	84	60
10	71	53	17	82	72	15	93	84
22	68	75	23	64	62	26	74	86
36	66	52	32	49	53	31	82	81
Total ..	260	225		269	247		333	311
Average per plot.	65	56		67	62		83	78
			Yield in lb. per acre.					
	1,964	1,607		2,642	2,143		3,000	2,143
	2,536	1,393		2,928	2,571		3,840	3,000
	2,821	2,678		2,286	2,214		2,642	3,072
	2,357	1,857		1,750	1892		2,928	2,893
Total ..	9,678	8,035		9,606	8,820		12,410	11,108
Average per plot.	2419·5	2,069		2401·5	2,205		3102·5	2,777

Plant chemistry study of quality in chewing tobacco from Jaffna and Meenampalayam.—At the instance of the Government, an investigation was started on the possibility of improving the taste of Meenampalayam tobacco. Work was started towards the end of the year 1940–41 and an interim report was submitted in April 1942.

The problem arose out of a suggestion by the Principal Information Officer to the Government of India that in view of the large imports of Jaffna tobacco for chewing in spite of the fact that it fetched a much higher price in certain parts of India than Meenampalayam tobacco, whether it was possible to make Meenampalayam tobacco to have the same value as Jaffna tobacco.

This suggestion arose out of a remark by the Marketing Adviser to the Government of India in his Report on the Marketing of Tobacco in India that the two types of tobacco when subject to a preliminary examination at the Imperial Agricultural Research Institute at Delhi, showed that the micro flora present in the two types of leaf was different and that possibly by transferring the micro flora of Jaffna leaf on to that from Meenampalayam, the same desirable flavour could be obtained.

The Director of the Imperial Agricultural Research Institute was of the opinion that the differences in the micro flora were of little moment though there were differences in the types of colonies as obtained from cultures from the two types of tobacco and that the micro-organisms were purely casual, having nothing to do with quality in the two types of leaves.

Samples of tobaccos from Jaffna were obtained by the courtesy of the Tobacco Officer, Ceylon and Meenampalayam leaf from the local market and from Palghat which is a distributing centre for such leaf. Details were collected of the method of

curing in Jaffna and as used locally and the investigation was started on the samples of leaf obtained.

The results of the investigation which have been reported on may be summarized as follows :—

(i) The curing processes at the two centres of production are rather different, that used at Jaffna includes one stage of subjection to treatment with smoke from burning coconut husk and palmyra leaves in a smoking hut while that at Meenampalayam includes a prolonged bulking and treatment with jaggery water.

(ii) The two types of tobacco leaf resemble each other closely in physical appearance, though the Jaffna leaf has a much less pungent aroma than the Meenampalayam leaf.

(iii) Chewing tests by experienced tobacco chewing addicts revealed the fact that Jaffna tobacco was very mild as compared to Meenampalayam.

(iv) Chemical analysis showed that Jaffna leaf had a low nicotine content when compared to Meenampalayam leaf while all other chemical constituents were nearly alike.

(v) Becteriological analysis of the micro-organisms present revealed that in both cases the organisms present were very similar and were all casual organisms which could not be expected to take any part in the curing processes, but probably occurred on the cured leaf as a result of exposure during the curing processes.

(vi) The results pointed to the fact that the Jaffna and Meenampalayam tobacco were different varieties of the species *Nicotiana tabacum*. The two varieties being differentiated by their nicotine contents and that the preference for Jaffna tobacco was a regional preference for addicts in Travancore and Cochin for a milder tobacco.

The question of the differences in the methods of curing and the effect of soil and climate on the quality of the two types of tobacco was under further investigation. Both types of tobaccos were grown at Coimbatore under identical conditions in small field plots. Both the types of tobacco came up satisfactorily and the leaf was harvested and cured according to the method followed at Meenampalayam. The analysis of these cured tobaccos is in progress. Plots have been laid out for the next season for growing the tobaccos again during the next season, for curing both types by both processes, i.e., that used in Jaffna and that at Meenampalayam and further results of analysis will be reported on in due course.

Biochemical study of the changes taking place during the growth of tobacco as affecting quality.—A continuation of the study reported on above was conducted on the plots of tobacco grown at Coimbatore on three varieties of tobacco, i.e., Jaffna, Meenampalayam and Virginia. Seeds were sown on well-prepared seed beds, and the plants transplanted out on six plots which had been

previously growing pastures in the animal nutrition buildings. Seasonal conditions were generally satisfactory and all the three varieties made good growth. Samples of leaf were drawn at fortnightly intervals for a chemical study. The plants in all the plots were treated separately, one set being 'topped', i.e., inflorescence removed and the other allowed to flower freely. Topping of Virginia tobacco is an usual procedure in the tobacco-growing areas of Guntur and Godavari districts.

The results of analysis of the fresh leaf as picked at fortnightly intervals may be stated in brief as follows :—

(i) Topping brings about an increase in the nicotine content of the leaf, the effect being very marked.

(ii) Jaffna tobacco grown under conditions at Coimbatore gave a uniformly higher nicotine content than that of Meenampalayam tobacco at most stages of growth, a result which is entirely different from that obtained from the comparative analysis of cured leaf grown at Jaffna and Meenampalayam.

Further studies are in progress and will be reported on when completed.

Animal nutrition—Feeding standards for working bullocks.—The experiments which have been in progress at all the Agricultural Research Stations of the department were continued at some of the stations where the results of the last year were doubtful, i.e., at Hagari, Tindivanam and Nandyal. At all these stations the data were examined and it was seen that in all cases the roughage fed was insufficient for the large-sized animals under experiment there. The results received during the year showed that at Hagari the revised rations supplying sufficient roughage at 25 lb. per day were suitable when used in conjunction with the slab system of rations for concentrates. The work animals maintained their condition and weight.

At Tindivanam the animals were reported to have lost condition as reported on by the Superintendent, but calculated live weights from linear measurements did not show any such condition.

The new trial was only started on 1st March 1942 at Nandyal and results are awaited.

Microbiology—Micro-biological population of black soils.—The work on the micro-biology of the black soils of Madras Deccan before and after the introduction of irrigation was continued. Previous work had shown that the soils under dry conditions had a very poor population of micro-organisms when compared with the other arable soils and also black soils of other parts of the Province. Such a condition, it has been already pointed out, was correlated with a low organic matter status. During the year under report, the micro-biological study of the same soils after one season of irrigation was completed. The results are interesting; and showed that in the soils taken from the Agricultural Research

Station, Siruguppa, before and after irrigation, there was a marked increase in the total bacteria per gramme of soil, and that the nitrate formers had improved considerably in numbers. These results showed that as a result of irrigation and cultivation of the lands with applications of manure to improve the organic matter status the micro-biological activity had been considerably improved as seen by higher counts of micro-organisms and a better capacity for nitrification. The organic matter status is still low and needs to be further improved, and samples of soil drawn after two seasons of irrigation and cultivation with application of organic manures are under analysis and results are awaited with interest. The table below gives details of micro-biological analysis of the four soil types drawn from typical areas at the Agricultural Research Station, Siruguppa :—

TABLE.

Soil sample from B'ock number.	Total counts of Bacteria per gramme of soil.		Nitrate formers per gramme of soil.	
	Pre-irrigation.	Post-irrigation.	Pre-irrigation.	Post-irrigation.
Block No. 3 ..	694,000	3,350,000	Trace.	100
Block No. 5 ..	656,000	3,750,000	,,	1,000
Block No. 7 ..	1,209,000	3,640,000	,,	1,000
Block No. 8 ..	571,000	4,590,000	,,	1,000

These results read along with those presented in the Annual Report of the Agricultural Research Station, Siruguppa, for 1941–42, for the movement of salts in the soil profile show that irrigation has had a beneficial effect on the fertility status of the soils in not only washing down the salts in the profile but also improving the micro-biological population of the soils and thus making for a better fertility status of the soils which have been for long ages under a regimen of dry conditions as a result of the arid conditions prevalent in the tract.

Malt chemistry—(a) Commercial scale production of malt food.— The process developed in this laboratory for the malting of cholam for the manufacture of a malt food, to replace the malted foods made out of barley now being imported from abroad was developed on a semi-commercial scale since the last year. The report of this section for the year 1940–41 gives details of the pilot plant set up for the purpose. The difficulties encountered and how they were overcome has been described in that report. The pilot plant continued in operation till about the end of March 1942.

Government ordered that a large-scale plant be designed and erected for the manufacture of cholam malt food capable of producing about 36,000 lb. malt food per annum. Detailed estimates were submitted and the scheme was sanctioned in December 1941 when work was started at once, and the large-scale plant was erected and in working on the 1st April 1942.

The large-scale plant was designed to obviate all the defects of the pilot plant. The large-scale plant consisted in units for (i) steeping, (ii) couching, (iv) roasting, (v) polishing, (vi) grinding, (vii) sieving and (viii) packing. Since no machinery was available for importing from abroad, all the units were designed in consultation with the Research Engineer and built locally. The steeping units consisted of nine vats of galvanized iron, with arrangements for blowing air, with outlets for the steeped grains. The couching units were the most difficult to design and construct, but recourse had to be made for purchasing 'Carrier air conditioning' units from Messrs. Volkart Bros., Madras. The roasters were locally built in the workshops of the Research Engineer as were the sieving units. The grinding machines were built to our specifications by Messrs. P. S. G. & Sons, Industrials, Limited, Coimbatore. The packing units were also built by the same firm from a pattern used by Messrs. T. Stanes & Co., Limited, at their United Coffee Works, Coimbatore.

The steeping vats were designed to contain 100 lb. of grains each, and were fitted with devices for drawing out the steeped grains, air inlets for blowing in air periodically from a blower and water-supply from the water mains. Nine such units were installed.

The couching chambers were built of tubular bricks to equalize temperature at all times of the year and were fitted with the carrier air conditioning units to keep the temperature round about 65°–70° F all day and night. Each chamber was fitted with wooden racks to hold anything up to 1,000 lb. of grain for germination.

The roasters were built to have a capacity of 70 lb. each and consisted of a circular iron pan with a centrifugal stirrer of steel blades and heated by a charcoal furnace. Four such units were installed.

The polishing mills designed and built by the Research Engineer consisted of a heavy plate of iron rotating along a vertical axis inside a steel chamber lined with emery abrasive. The malted grains when put into the polishing mill were forced on to the sides of the emery lined side walls and all the husks were removed by this process. Three such units were installed.

Grinding was done by a grinding mill with a steel cone with grooves working against another inverted cone. This was built by Messrs. P. S. G. & Sons Industrials. Sieving was done by a sieve built by the Research Engineer, consisting of a base plate with 100 mesh gauge, on which four beaters of leather were circulating in an horizontal direction, run by gearing from a vertical shaft. Four such units were built and installed.

The packing process adopted was vacuumizing the containers and then passing in carbon dioxide gas to fill up the spaces in the bottles packed with the malt food. The vacuumising

removes all the air present and the carbon dioxide being an inert gas filling up spaces occupied by the interspaces in the malt food, prevents spoilage. The plant required for this process consisted of a pressure chamber evacuated by a compressor working in reverse and removing all the air and a supply of carbon dioxide supplied from a cylinder of the compressed gas. The compressor makes a vacuum and this is filled up by the carbon dioxide gas. This unit was built by Messrs. P. S. G. & Sons Industrials, Coimbatore.

The plant was installed and in working condition early in April 1942 and the malt factory came into operation from then. The Business Manager was appointed on 1st June 1942 and the factory has been in partial operation since that time till time of report.

(*b*) *Research work on the process for making malt food.*— During the operation of the pilot plant for making of malt food, the question of the diastatic activity of the malt food produced was under investigation, with a view to meet the needs of the Defence Department regarding the diastatic activity of the food so produced. The specifications for a 'malt' as prescribed by the Defence Department were for a malt of diastatic activity of 25° lintner. The malt food produced at Coimbatore had an activity of only 4°–8° lintner, which were not anything like what was required by the Defence Department.

Work was carried out on the reasons for this low value of cholam for its diastatic activity. Experience in other countries has shown that in South Africa Lazar working with Kaffir corn (*Sorghum cafforum*) as reported in the *Journal of South African Chemical Institute* (1938, Volume 21, pages 23–32) the diastatic activity of Kaffir corn, a closely related variety to cholam was between 0–8° L. Studies on cholam as locally available were conducted and it was seen that even with a prolonged couching period of 12 days the diastatic activity reached maximum of 20·4° on the twelfth day and fell thereafter. On roasting the malted grains, the value fell to 4°–8° L. Trials with wheat, barley and rice were also conducted under low temperature for a long period of days. It was found that wheat gave very high values of a diastatic activity of up to 96° L after 9 days. Barley gave values up to 40° L

The lintner value is a measure of the capacity of the enzyme in malt to convert starch into maltose ; the higher the value the better the capacity to solubilize starch into maltose. One way of increasing this value with cholam is to attempt to prolong the period of couching, i.e., by suppressing the germination by lowering temperature during couching. Cholam grains after steeping were placed in the cold chamber and samples drawn every other day for analysis for lintner value. It was seen that by prolonging the period of couching under low temperatures the lintner value rose from 9·8° on the fourth day to a

value of 20·4° on the eighth day. This was for the grains reviewed periodically after each day's couch and roasted partly before determination of lintner value. The process of roasting was important in determining the lintner value, which dropped markedly on slight rise of temperature during roasting. One lot of cholam grain couched for 7 days and then sun dried to 12·0 per cent moisture gave a value of 26·2° L.

Ragi grain when similarly treated for delayed germination, gave disappointing results, the lintner value only reached 5·3° after nine days couch. Barley grain under the same conditions gave 41·0° L after 7 days couch.

It is clear that each cereal has an inherent capacity for malting as measured by the lintner value after suppressed germination. With cholam values of 19–20° L can be easily obtained but above that there are technical difficulties in the way, ragi can be made to reach a value of 5–6° L. Paddy cannot be forced beyond 4° L while with wheat very high values can be reached of 53° L after roasting which is higher than that for barley (about 40–45° L).

Lintner value of proprietary malt foods.—The lintner values of malt foods well known in the open market were under further study. Preliminary analysis showed very low values. Five such foods were analysed. Tazle below gives details of the diastatic value obtained in each case :—

Malt food	Diastatic value expressed as °L.	Type of food.
No. 1 ..	4·4 ..	Malted milk type.
No. 2 ..	2·5 ..	Do.
No. 3 ..	27·2 ..	Composite malt-egg type.
No. 4 ..	47·2 ..	Composite milk-cocoa-egg type.
No. 5 ..	1·9 ..	Malted milk type.
No. 6 ..	Nil. ..	Do.

The malted milk types Nos. 1, 2, 5 and 6 had low lintner values while the composite malt-egg and malt, cocoa and egg type had very high values (Nos. 3 and 4). Cholam malt food without addition of milk resembles the malt-milk type so popular as infant and invalid foods. The preparation of the malt-egg and malt-cocoa-egg types Nos. 3 and 4 with a high lintner value needs further laboratory research since the methods of manufacture of such foods are covered by patents which are strictly guarded and details not available even to scientific workers. Malt food made from cholam by the process developed in this laboratory can thus be classified along with malt foods bearing names which are household words in this country as regards its diastatic value.

Malt extract from cholam.—The preparation of a light coloured malt extract suitable for blending with shark liver oil was under investigation. The improved technique developed some time ago was tried out on a large laboratory scale by the daily treatment of material to make a sufficient quantity of malt extract to be sent as test samples for the approval of the Supply Department, Foodstuffs Directorate. It was found at the very start that the preliminary stages of extraction of malt and treatment for clarification took up too much time, so that by the time the extract was sent in to the vacuum still for concentration, fermentation began to set in. The process was therefore shortened and good samples of concentrated syrup were obtained during a 12-hour working day. The whole meal cholam malt was treated with twice its weight of water at 60°–65° C., being kept at that temperature for one hour. The extract was filtered off through fine muslin cloth, and the filtrate treated with 1 per cent active carbon and again filtered clear under pressure. This operation took about 1½ hours to complete. The clear filtrate was then concentrated in vacuo to the consistency of a thick syrup. This was completed in about 10 hours for roughly 2,000 c.c. of clear filtrate.

The mixing of malt extract with shark liver oil was done in batches of 500 c.c. at a time in large beakers with an electric stirrer. The thick extract was stirred vigorously and 3 per cent of shark liver oil run into the stirring mass. Samples were drawn periodically to study the degree of dispersion of the oil in the malt extract as an emulsion. The samples drawn were put on to a microscope slide and a smear made and examined under low power. It was seen that stirring for one hour resulted in a multi-phase dispersion of the oil, the oil being in globules of two or three sizes-small, medium and large. Further stirring for another hour resulted in a more uniform size of globules. The exact time required for the stirring has to be determined since it depends on the viscosity of the extract, before a uniform monophase dispersion of the oil is obtained. A sample of a well-known malt extract and cod liver oil placed on a micro-slide as a smear is being used as standard. Work so far has shown that stirring with the new malt extract for about 2-3 hours is sufficient to ensure a uniform monophase dispersion of the shark liver oil.

Malt extract semi-commercial scale plant—Trials with the pilot plant.—Trials with the pilot plant consisting of a vacuum distilling plant built by Messrs. Andhra Scientific Company of Masulipatnam with extraction and filtering apparatus devised from laboratory apparatus available were conducted from the 7th of February when the vacuum still was installed and steam suction and water connexions were made. The trials have been in progress daily from that date, and data has been collected to give an estimate of

the capacity of the pilot plant, the quantities of extract that can be obtained from a given quantity of cholam malt, and the cost of production of the material.

The process of making malt extract as developed on the laboratory scale and tried out on the semi-commercial pilot plant scale appears to be full of promise of success for production on a full factory scale for placing on the market for sale to the general public.

Modifications in the process as tried out by pilot plant—Stage 1.—The extraction of malt (green, coarse and fine malt) by maceration in a vessel heated to 60° by steam was satisfactory, even with large quantities of material going up to 12 lb. at a time of raw material. The process of ordinary filtration with funnels and through muslin was found to be too slow.

In dealing with the large quantities of filtrate, as was found necessary with the pilot plant and anything up to 18,000 cc. per day, this method of filtering through muslin was found to be unsuitable. Recourse had to be made to the use of a centrifuge, and it was found that a power-driven sugar centrifuge with a cloth lining for the wire basket was very efficient in separating out a semi-turbid liquid in large quantities at a rapid rate. The sugar centrifuge could deal with 20,000—30,000 cc. of liquid, removing the solid and colloidal matter from a semi-turbid liquid in the course of one hour.

Stage 2.—The adding of 3 per cent active carbon to the turbid filtrate was changed to filtering off the turbid liquid on a bed of active carbon in suction filters. The former method was slow in action, while the filtration of the turbid liquid from the centrifuge in stage 1 on a bed of active carbon on a vacuum filter was much more rapid and yielded a clear filtrate, and it was possible to treat 20,000 cc. of filtrate in about half as much time as in the former method. Large-scale copper filters have been designed to deal with large-scale filtration.

Stage 3.—The vacuum still which deals with the final clear filtrate from stage 2 was limited by a stated capacity of one gallon, i.e , 4,500 cc. but with a really effective capacity of about 3,000 cc. per charge, any charge above that resulted in frothing over into the receiver and loss of material during distillation and lowering of capacity. The vacuum still had to be continuously fed with batches of material of about 3,000 cc. of filtrate at a time during the 8 hours of operation to give maximum output of 2 1/2-3 lb. malt extract per day.

A modified vacuum still has been designed and is being built by the Research Engineer with a total capacity of about 36,000 cc. and an effective capacity of 14,000 cc. per charge and this type

of still will be the one to be used as a unit in the factory scale production proposed. One unit of this new still is expected to produce about 8–10 lb. malt extract per day.

The capacity of the pilot plant for making malt extract was found to be about 3 lb. extract per day and the percentage of extraction from coarse malt meal 25 per cent. The cost of production of malt extract without shark liver oil added worked to about Rs. 2 per lb. without packing.

Proposals were submitted for the establishment of a large-scale plant for the making of malt extract fortified with high potency shark liver oil from the Shark Liver Oil Factory at Kozhikode. sanction was received for the same and work is in active progress to begin production at an early date. Most of the plant is being supplied by Messrs. Andhra Scientific Company, Masulipatnam, and at the time of report the bulk of the plant has been received and is being installed.

The full-scale production is expected to amount to 15,000 lb. of malt extract with shark liver oil, with 1 per cent mixture of shark liver oil, will have about 200 I.U. vitamin A and vitamin D in addition.

The following table gives details of the chemical composition of malt extracts as made at Coimbatore and as available on the market of different brands which have been given as commercial samples 1–4.

Heads of analysis.	Malt extract.				
	Coimbatore.	Commercial sample No. 1.	Commercial sample No. 2.	Commercial sample No. 3.	Commercial sample No. 4.
	PER CENT.	PER CENT.	PER CENT.	PER CENT	PER CENT.
Specific gravity ..	1·396	1·305	1·496	1·440	1·200
Total reducing sugars (as maltose).	65·54	47·22	62·58	63·32	61·60
Crude protein ..	4·46	3·26	5·16	..	4·26
Diastatic activity ..	6·9° L	9·6° L	..	1·05° L	3·2° L

It may be mentioned that commercial samples Nos. 1, 2 and 4 are made abroad, while No. 3 was made in India. All the commercial samples were dark in colour and with a caramel smell in them, while that made at Coimbatore was light coloured, sweet to taste and without any trace of caramel.

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Coimbatore.

DETAILED ADMINISTRATION REPORT OF THE GOVERNMENT MYCOLOGIST FOR THE YEAR 1941-42.

I was in charge of the Mycological section and the Microtome section throughout the year.

The activities of the section are classified and reported on under the following heads :—

I.—Mycological research.
II.—Virus disease research.
III.—Advisory work.
IV.—Quarantine service and legislative measures.
V.—Propaganda.
VI.—Teaching.
VII.—Microtomy.

I.—Mycological Research.

1. *Rice—'Blast'—Piricularia oryzae—Studies on varietal resistance.*—Sixty-nine cultures of paddy kindly supplied by the Paddy Specialist were tested for their relative resistance to Piricularia under field condition in the Central Farm at Coimbatore. The cultures tested belong to the following classes :—

Selections from crosses of Co. 4 × Adt. 10	29
Selections from crosses of G.E.B. 24 × Adt. 10 ..	31
Selections from Chingleput sirumani	4
Selection from Salem Pudupatti samba	1
Other strains (Co. 4, G.E.B. 24, Adt. 10, Adt. 11) ..	4

The planting was done about the middle of September. Piricularia infection was noticed in the Adt. 10 outskirts and in a few of the experimental plots during the first week of October. Though secondary infection was observed in all the plots up to the end of December, the spread of infection was not up to the usual standard. Artificial infection by spraying conidial suspensions in water on the outskirts was resorted to during the last week of December. This method yielded a considerable number of infected plants in all the varieties under trial thus making it possible to evaluate their resistance to Piricularia infection.

The amount of leaf, node and neck infection was recorded for all the cultures under trial. The following tabular statement gives the percentage of infection based on neck attack :—

TABLE I.—*Statement showing the percentage of infection in sixty-nine cultures of paddy.*

Serial number.	Paddy Specialist's culture number.	Percentage of neck infection.	Serial number.	Paddy Specialist's culture number.	Percentage of neck infection.
(1)	(2)	(3)	(1)	(2)	(3)
1	Co. 4	14·7	36	4049	39·3
2	4005	24·9	37	4051	39·3
3	3994	26·6	38	4047	39·9
4	3980	26·7	39	4048	39·9
5	4072	27·8	40	G.E.B. 24	40·0
6	3843	28·4	41	P. Samba	40·5
7	3988	29·4	42	3942	40·5
8	4008	29·9	43	4038	42·6
9	3959	30·0	44	4013	42·7
10	3911	30·5	45	4050	43·6
11	3982	30·9	46	3842	43·8
12	3993	30·9	47	3892	44·3
13	3989	31·1	48	4070	45·2
14	3990	31·3	49	3915	45·3
15	3895	31·4	50	3832	46·6
16	3937	31·7	51	3835	46·7
17	3850	33·2	52	5355	46·8
18	3912	33·7	53	3919	47·4
19	4054	34·0	54	4031	47·4
20	3967	34·3	55	3866	47·5
21	5377	34·4	56	3839	47·7
22	3969	34·5	57	4033	48·3
23	3992	35·0	58	5320	48·6
24	3882	35·1	59	3840	48·7
25	3991	35·4	60	3913	49·3
26	3906	35·5	61	3931	49·6
27	4055	35·8	62	4059	50·3
28	3975	36·2	63	3910	50·5
29	4067	36·2	64	3862	50·6
30	3998	36·4	65	5337	54·5
31	3941	36·7	66	3921	54·9
32	3883	37·0	67	3914	62·5
33	3938	37·1	68	3841	65·1
34	Adt. 11	37·9	69	Adt. 10	75·4
35	3953	38·9			

It will be seen from this statement that all the selections except Co. 4 show infection ranging from 25 to 75 per cent indicating their susceptibility. Even Co. 4 a highly resistant variety under normal cultural conditions shows about 15 per cent infection. The high degree of infection in all the varieties is attributable to the artificial infection carried out during the last week of December.

Cross inoculations.—*Piricularia oryzae* was found to infect wounded and unwounded leaves of *Digitaria marginata*. The isolation from the latter was also found to infect leaves of paddy seedlings.

2. *Comparative studies of four isolations of Piricularia species from four different hosts.*—Comparative growth of four isolations of Piricularia, viz., *P. oryzae*, *P. setariae*, and Piricularia species from ragi and *Digitaria marginata*, respectively, were studied on seven agar media. The details regarding the nature of each medium

and the mean growth obtained in each are given in the following tabular statement :—

TABLE II.—*Average linear growth of four species of Piricularia at the end of nine days.*

Media.	Paddy Piricularia.	Ragi Piricularia.	Tenai Piricularia.	Digitaria Piricularia.
	MM.	MM.	MM.	MM.
Oat meal agar	30·8	30·0	31·25	33·8
French bean agar	27·75	30·0	28·75	22·3
Paddy decoction agar ..	27·6	26·8	27·5	27·8
Tenai decoction agar ..	29·75	30·8	31·3	33·1
Ragi decoction agar ..	27·6	32·0	30·0	31·6
Richard's agar	28·75	24·0	26·6	18·5
Brown's agar	25·0	22·3	25·0	20·0

It will be seen from the growth obtained that oatmeal agar is the most favourable medium and Brown's the least favourable for the growth of the fungus.

Paddy 'foot-rot'—Fusarium moniliforme—Fungicidal trials.— To test the fungicidal value of the three mercury compounds received from Prof. T. R. Seshadri of Andhra University, experiments were started in the Central Farm. A fungicide known as N.G. 3399/9N supplied by the Imperial Chemical Industries and claimed to be non-poisonous, formalin-charcoal dust and the standard ceresan dry-dressing were also included in these trials. The experiments were laid out in the middle of August with eighteen treatments each repeated four times and arranged in randomized blocks. *Gobikar*, a strain of paddy, highly susceptible to 'foot-rot' (*Fusarium moniliforme* var. *majus*) was used for the trials. The seeds were first treated with spore suspensions of the causal organism air-dried and then the individual treatments applied. Equal quantities of seeds were sown in randomized plots replicated four times. Periodical observations were taken twice a week from the time of sowing for about five weeks when the experiments were concluded. The following tabular statement records the results obtained :—

TABLE III.—*Relative efficiency of different seed treatments against 'foot-rot'.*

Date of sowing—15th August 1941.
Date of final observation—22nd September 1941.

Treatments.	Nature of treatments.	Strength.	Incidence of disease.
			PERCENTAGE.
A Compound I (mercury urea) ..	Dust ..	1 gm. per lb.	5·2
B Do. ..	Do. ..	0·5 gm. per lb. ..	3·7
C Compound II (Succinimide mercury compound).	Do. ..	1 gm. per lb.	3·9
D Do.	Do. ..	0·5 gm. per lb. ..	2·9
E Do.	Do. ..	Diluted with French chalk at 1 in 2 parts.	2·6

	Treatments.	Nature of treatments	Strength.	Incidence of disease.
				PER CENTAGE.
F	Compound II (Succinimide mercury compound).	Dust ..	Diluted with French chalk at 1 in 5 parts.	4·6
G	Do.	Do. ..	Diluted with French chalk at 1 in 10 parts.	3·7
H	Do.	Do. ..	Diluted with French chalk at 1 in 20 parts.	6·6
I	Do.	Steep (for half an hour).	Diluted 1 in 50 parts of water.	5·4
J	Do.	Do.	Diluted 1 in 100 parts of water.	2·7
K	Do.	Do.	Diluted 1 in 500 parts of water.	3·8
L	Do.	Do.	Diluted 1 in 5,000 parts of water.	7·0
M	Compound III (Phthalimide mercury compound).	Dust ..	1 gm. per lb.	5·9
N	Do.	Do. ..	0·5 gm. per lb. ..	6·8
O	N.G. 3399/9N (Imperial Chemical Industries preparation).	Do. ..	1 gm. per lb.	4·5
P	Formalin charcoal dust ..	Do. ..	1·5 gm. per lb. ..	35·7
Q	Ceresan	Do. ..	1 gm. per lb.	1·8
R	Control	..	....	37·5

Critical difference—3·68.

The results were statistically analysed. The order of arrangement for the efficacy of the various treatments are given below :—

Q E J D B G K C O F A I M H N L P R

The following conclusions may be drawn from the analysis of the results obtained :—

(1) Ceresan is found to be the most effective.

(2) Succinimide mercury compound is as effective as ceresan both as a dry-dressing except when diluted to 1 in 20 and as a steep except in a dilution of 1 in 5,000.

(3) All the treatments except formalin-charcoal dust are able to control the disease.

(4) There is no significant difference between the formalin-charcoal dust treatment and the control.

(5) The control shows the heaviest infection.

3. *Helminthosporiose of cereals—Paddy—Helminthosporium oryzae—Physiological studies—Growth in relation to pH. Helminthosporium oryzae* was grown in Waksman's solution having pH values ranging from 6·18 to 8·50. After ten days the weights of

the dry mycelial mats were determined to find out the optimum pH for the growth of the fungus. The results showed that the best growth was obtained at 7·61 and the least at 8·50.

Nitrogen metabolism of Helminthosporium oryzae.—The fungus was cultured in a basic medium to which different sources of nitrogen were added. The basic medium selected was Waksman's agar without peptone. Nitrogen was added to this medium in the form of peptone, asparagin, potassium nitrate, potassium nitrite or ammonium sulphate. The results of the experiments showed that good growth was obtained in peptone, asparagin and potassium nitrate, poor growth in ammonium sulphate and no growth in potassium nitrite. Measurements of spores produced with various sources of nitrogen were also taken. The following table gives average daily rate of linear growth of the colony and the spore measurements :—

TABLE IV.—*Linear rate of growth and spore size of Helminthosporium oryzae in media with different sources of nitrogen.*

Source of nitrogen.	Linear rate of growth per day.	Spore size and septation.		
		Mean length.	Mean width.	Mean number of septa.
	MM.	U.	U.	
Peptone	7·13	90·11	15·91	7·15
Asparagin	6·11	78·31	15·69	5·74
Potassium nitrate	5·75	83·48	15·35	7·86
Do. nitrite	No growth.			
Ammonium sulphate ..	2·61	74·24	15·54	5·66

It will be seen from the statement given that the rate of growth is in the order of peptone, asparagin, potassium nitrate and ammonium sulphate while spore length is in the order of peptone, potassium nitrate, asparagin and ammonium sulphate.

Percentage of soil moisture in relation to the incidence of primary infection.—Seeds were sown in pots containing soil adjusted to 30 per cent, 50 per cent and 70 per cent of moisture to weight of dry soil. The pots containing the lowest percentage of moisture showed the highest amount of seedling infection, the 50 per cent moisture series showing less and the 70 per cent series the least amount of infection.

Effect of steeping in alcoholic mercuric chloride solution on the incidence of primary infection.—Steeping the seeds in 0·1 per cent solution did not control the disease to any appreciable extent. To obviate the possibility of tiny bubbles of air trapped outside and inside the glumes thus preventing complete contact with the fungicide, steeping under reduced pressure was tried and found successful, the degree of freedom from disease rising to 75 per cent against the 20 per cent obtained for the steeping under normal atmospheric pressure. Steeping under reduced pressure for 10 minutes duration gave better results than steeping for 5 minutes.

Control by seed treatment with ceresan.—To find out whether seed treatment with ceresan at the rate of 1 gram per pound of seed can control infection present in apparently diseased seed material, treated and untreated diseased grains were sown separately in agar plates. There was 15 to 20 per cent of disease in the treated series, while the controls gave 80 per cent infection. In another series the treated and untreated seeds were covered with soil after being sown in agar plates. In this series the ceresan treated seeds gave only 8 per cent disease, while the control showed 30 per cent infection. Though there was a certain amount of infection in the treated series, the infection appeared 6 to 7 days later than in the controls thus showing that the fungicide sticking to the glumes inhibits the growth of the fungus for about a week. This allows time for the seedlings to develop and escape primary infection during the most vulnerable period of their growth.

Source of infection in infected grains.—To find out whether viable mycelium is present in the glumes as well as in the kernels, apparently infected grains were selected and treated with 0·1 per cent alcoholic mercuric chloride for 10 minutes under reduced pressure and then washed in sterilized water. The glumes and kernels were separated under aseptical conditions and then plated in agar media. The results showed that the fungus colonies invaribly developed round the kernels, while the glumes showed colonies only rarely. This suggests that the infected kernel is a more potent source of infection than the glumes. Further work is in progress.

Varietal resistance in relation to period of planting.—Twelve Mtu. varieties Nos. 1 to 12 were planted from August to September and the incidence of disease in each was recorded up to the time of the harvest. Of the twelve varieties, Mtu. 10, 11, 12, 7 and 8 showed mild infection, while Mtu. 2, 5, 1 and 4 showed slightly heavier infection while Mtu. 3, 6 and 9 showed the heaviest infection. All the varieties showed the heaviest infection in the August planted crop and there was a gradual reduction in subsequent monthly plantings. August which is the usual planting season in Coimbatore coincides with the planting period most favourable for high infection.

4. *Ragi blast—Piricularia sp.—Varietal resistance in relation to time of sowing.*—Eighteen varieties of ragi ranging in duration from 105 to 135 days were under field trial. Sowing of nurseries was so timed that transplanting was carried out in July, August and September. All the plots were under observation till the time of harvest in October, November and December, respectively. Though leaf infection was found to be present in all the varieties during the nursery stage, it was found to decline and finally disappear in the transplanted crop. Ear and neck infection was, however, found to develop during the heading stage. The July-planted crop harvested in October escaped infection while the August and September plantings harvested in November and December

showed infection ranging from 0·3 to 35·2 in the former and 23·5 to 71·9 in the latter. These results therefore showed that none of the varieties tried was immune but September was the most unfavourable month for planting and July the most favourable. Further observations also showed that the heavy infection period coincided with high atmospheric humidity during the heading stage.

Direct control methods.—Spraying bordeaux mixture or dusting with sulphur at the earing time did not control the disease to any appreciable extent.

5. *Tenai blast—Piricularia setariae—Varietal resistance trials*—Fourteen strains of tenai kindly supplied by the Millets Specialist were sown under field condition to ascertain the relative incidence of natural infection in them. Leaf infection was observed when the plants were about three weeks old. Ear infection was absent. The incidence of leaf infection was recorded throughout the duration of the crop and was found to range from 0·4 to 15·8 per cent for the varieties under trial. Though none of them was completely free, S. I 1383 was the most resistant with only 0·4 per cent against 15·8 in the most susceptible variety, S.I 2971.

Inoculations.—Artificial inoculations with spore suspensions of *Piriculara* on three-week-old *tenai* seedlings showed infection in all the fourteen varieties.

6. *Areca palm—Mahali Phytophthora arecae—Field experiments in South Kanara for control of Mahali.*—The experiments for the control of Mahali of arecanuts were repeated with a few modifications at Mundaje in South Kanara. Resin which was consistently found to be less effective than other adhesives especially in combination with 1 per cent bordeaux mixture was dropped out. As the rainfall at Mundaje is heavier than in the coastal areas of South Kanara, it was also decided to ascertain whether three sprays would yield better results than two sprays. Two gardens were selected for the experiments. For want of sufficient natural infection, one of the gardens was abandoned during the progress of the experiments. In the other where there was widespread infection, the results were recorded and statistically analysed.

TABLE V.—*Results of field experiments at Mundaje (South Kanara) on the control of Mahali of area palm.*

Mixture and adhesive used.	Strength of bordeaux mixture for first spray.	Strength of bordeaux mixture for second spray.	Strength of bordeaux mixture for third spray.	Percentage of infection.
	PER CENT.	PER CENT.	PER CENT.	
A Bordeaux mixture casein at 2 lb. per 100 gallons.	2	2	..	2·72
B Do.	1	2	..	5·81
C Do.	1	1	..	4·92
D Do.	1	1	1	7·86

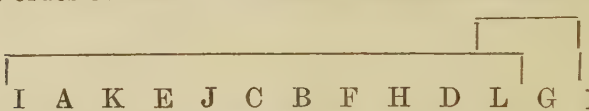
Mixture and adhesive used.	Strength of bordeaux mixture for first spray. PER CENT.	Strength of bordeaux mixture for second spray. PER CENT.	Strength of bordeaux mixture for third spray. PER CENT.	Percentage of infection.
E Bordeaux mixture with niger oil at 80 oz. per 100 gallons.	2	2	..	4·12
F Do.	1	2	..	6·00
G Do.	1	1	..	17·32
H Do.	1	1	1	6·94
I Bordeaux mixture without adhesive.	2	2	..	0·93
J Do.	1	2	..	4·79
K Do.	1	1	..	3·87
L Do.	1	1	1	9·57
M *Control*	No spraying			38·59

Dates of first spraying—1st and 2nd June 1941.

Dates of second spraying—14th and 19th July 1941.

Dates of third spraying—1st to 3rd August 1941.

The order of merit of different treatments is as follows :—



The following conclusions were drawn from the results of statistical analysis of the data collected :—

(1) The control showed the heaviest infection.

(2) All sprays were not significantly different from one another except 1 per cent oil bordeaux mixture.

(3) The results of two sprays were not significantly different from those of three sprays ; hence two sprays are enough to control the disease.

(4) Spraying with 1 per cent bordeaux mixture was as good as the 2 per cent mixture.

(5) Plain bordeaux mixture was not significantly different from those mixtures with adhesives falling within the critical difference.

The above results confirm the results obtained in 1937–38 and 1940 41 about the unassailable position of plain bordeaux mixture and that adhesives of any kind are not required for effective control of the disease even under conditions of heavy rainfall.

7. *Studies of Phytophthoras of South India*—(*a*) *Phytophthora species from breadfruit.*—Sporulation of the fungus in Quaker oats, french bean and maize meal agars was studied.

In Quaker oats agar, it produced mostly chlamydospores in about three or four days. Sporangia were found to be very few and appeared later than the chlamydospores.

In french bean agar, sporangia were the first to be formed and in about three days they were found in large numbers. Chlamydospores were produced later than the sporangia and in fewer numbers.

In maize meal agar sporangia and chlamydospores appear at about the same time the chlamydospores predominating; the sporangia, however, are more numerous than in Quaker oats agar but less than in french bean agar.

The sporulation of the fungus was also studied in Petri's mineral solution, in pea broth and in distilled water. The fungus was found to produce sporangia in large numbers in all the three liquid media.

Measurements of the sporangia formed in French bean and Quaker oats agars and Petri's mineral solution and in distilled water were taken. The following table gives the summary of measurements of 200 sporangia taken from each of these media :—

TABLE VI.—*Measurements of sporangia of Phytophthora on bread fruit.*

Medium used.	Length.			Width.			Ratio
	Mean.	Mode.	Range.	Mean.	Mode.	Range.	
Quaker oats agar ..	32·9	33·25	22·75 42·0	25·2	22·8	17·5 33·25	1·31
Maize meal agar ..	33·82	35·15	22·22 46·25	25·75	25·90	18·5 33·3	1·31
French bean agar ..	34·96	32·40	25·2 46·8	26·17	25·2	18·0 36·0	1·34
Petri's mineral solution	26·12	26·25	17·5 35·0	21·32	19·25	14·0 29·75	1·22
Distilled water ..	23·56	24·0	17.5 29·75	18·87	17·5	14·0 26·25	1·25

Oogonia with *amphigynous autherida* were found in single strain cultures on maize meal agar as early as 13 days from the date of inoculation.

Comparative growth at critical temperature 32·5 °C (32–33° C) — As the *Phytophthora* species frombread fruit was killed at 35° C, the growth of this fungus was compared with the growths of *P. palmivora* from *palmyra* and *citrus*. P. *arecae*, *P. meadii* and *Phytophthora species* from *Spondias* and *Clerodendron*. The following table gives the average diameter of the colonies in maize meal agar at 32–33° C after four days.

TABLE VII–*Colony diameter of Phytophthora species at* 32-33° C *after four days growth on maize meal agar.*

Serial number and name of fungus.	Aveeage diameter of colonies.	Remarks,
	Cm.	
1 *Phytophthora palmivora*	6·7	
2 *P. sp.* (on *Clerodendron*)	5·4	
3 *P. sp.* (on *Spondias*)	5·2	
4 *P. arecae*	5·1	
5 *P. meadii*	3·6	
6 *P. palmivora* (on Citras nobilis) ..	2·8	
7 *P. sp.* (on bread fruit) No appreciable growth.		Not killed.

Though *Phytophthora sp.* from breadfruit was not killed at this temperature, there was no appreciable growth while in all the others belonging to the *palmivora* group the growth was marked. This suggests that the breadfruit *Phytophthora* has a lower limiting temperature for growth than other members of the *palmivora* group which fail to grow only at 38° C.

(*b*) *Phytophthora species from betel vine.*—The isolation of *Phytophthora* species from betel vine (Madras) was grown at 20° C in maize meal, Quaker oats and srench bean agars in combination with the following strains of *Phytophthora palmivora* : —

(1) *Phytophthora faberi.*
(2) *Phytophthora arecae.*
(3) *Phytophthora meadi.*
(4) *Phytophthora palmivora* (palmyra).
(5) *Do.* (coconut).
(6) *Do.* (Citrus nobilis).
(7) *Phytophthora sp.* from *Clero lendon.*
(8) *Phytophthora sp.* from *Spondias.*

Oospore formation was found in all the combinations except in those with *Phytophthora arecae* and *Phytophthora sp.* from *Clerodendron.* Examination of the paired cultures showed that though numerous oogonia with amphigynous autheridia are produced only a few of them come to maturity and develop oospores. French bean agar was found to be best medium for the formation of oogonia and oospores. In Quaker oats and maize meal agars oogonial production was rare and scattered.

Measurements of 200 oogonia and oospores taken from each of the six combinations that formed oospores are given in the tabular statement below :—

TABLE VIII.—*Measurements of 200 oogonia and oospores from the central zone of paired cultures in French bean agar.*

Serial number and nature of isolates grown together.	Oogonia.			Oospores.		
	Mean.	Mode.	Range.	Mean.	Mode.	Range.
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1 Betel vine *Phytophthora* plus *Phytophthora palmivora* (palmyra).	27·68	25·90	22·00 38·85	25·83	24·05	20·35 37·0
2 Betel vine *Phytophthora* plus *Phytophthora palmivora* (coconut).	26·75	25·90	22·20 33· 3	24·53	24·05	20·35 31·45
3 Betal vine *Phytophthora* plus *Phytophthora palmivora* (citrus).	27·42	25·90	22·20 31·45	25·57	24·50	20·35 29·60
4 Betel vine *Phytophthora* plus *Spondias Phytophthora.*	25·75	25·90	22·20 31·45	23·90	24·05	20·35 29·60
5 Betel vine *Phytophthora* plus *Phytophthora faberi.*	28·60	29·60	22·20 37·00	26·71	27·75	20·35 35·15
6 Betel vine *Phytophthora* plus *Phytophthora meadii.*	27·49	25·90	24·05 33· 3	25·64	24·05	22·20 31·45

The behaviour of the betel vine *Phytophthora* in paired cultures resembles that of *Phytophthora arecae* and *Phytophthora* species from *Clerodendron*, thus falling in Gadd's 'rubber group' of *Phytophthora palmivora*.

(*c*) *Phytophthora species from Jak* (*Artocarpus integrifolia*).—Repeated examination of the cultures on maize meal, quaker oats and french bean agars did not reveal the formation of oogonia in single strain cultures though Narasimhan had found them in Mysore for his isolation from Jack. Sporangia and chlamydospores were found to be produced in these media in varying degrees. Unlike the strains of *Phytophthora palmivora* where sporangia are produced in three or four days, they were produced in this case only after a week or ten days as is usual with *Phytophthora parasitica*. French bean agar was found to be the least favourable medium for sporangial production though this medium is found to be most favourable for sporangial production for the other isolations of *Phytophthora* species.

(*d*) *Phytophthora species from Jatropha curcas*.—Fruits of *Jatropha curcas* were found affected with a species of *Phytophthora* round about the Mahali infected areca gardens of Mundaje in South Kanara. The fungus was isolated into pure culture from specimens sent over from the affected locality. The isolation was found to produce sporangia, chlamydospores and oospores in single strain cultures. This is the first record of the isolation producing oospores in single strain cultures. Narasimhan was the first to isolate the fungus but working in Mysore he did not find oospores either in nature or in culture.

The isolation was grown in quaker oats and french bean agars and measurements of 200 sporangia and 200 chlamydospores were taken from each medium. The following table gives the analysis of measurements obtained :—

TABLE IX.—*Size of sporangia and chlamydospores of Jatropha Phytophthora.*

Medium.	Sporangia (in μ)			Chlamydospores (in μ.)		
	Mean.	Mode.	Range.	Mean.	Mode.	Range.
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Quaker oats agar.	51·28 × 32·10	49·0 × 31·50	33·25 — 73·5 × 24·5 — 38·5	34·13	35·0	24·5 — 45·5
French been agar.	47·60 × 35·35	45·50 × 35·0	33·25 — 61·25 × 28·0 — 42·0	33·71	31·5	24·5 — 43·78

Oogonia and oospores were found only in quaker oats agar. The analysis of measurements of 200 oogonia and 200 oospores are given below :—

TABLE X.—*Measurements of oogonia and oospores of Jatropha Phytophthora.*

	Mean diameter μ.	Mode μ.	Range μ.
Oogonia ..	30·28	29·75	26·75 — 36·75
Oospores ..	28·53	28·0	24·5 — 35·0

Pathogenicity.—Wounded and unwounded fruits of *Jatropha curcas* took infection easily. Wounded fruits showed discolouration at the place of inoculation within 24 hours while unwounded fruits took 2 to 3 ee days to show any discolouration. The infection thereafter began to spread and the entire fruit was covered in 5 to 6 days. The wounded and unwounded controls remained green throughout.

Inoculations of unwounded fruits of *Spondias mangifera* with the Jatropha isolation did not produce any infection.

8. *Ginger—Soft-rot—Pythium species—Storage experiments.*—The experimental storage pits in Taliparamba Research station were opened and the stored ginger under different treatments were examined. The following tabular statement gives the treatments tried and the results obtained :—

TABLE XI.—*Results of variously treated ginger rhizomes in storage.*

Serial number and treatments.	Weight of seeds preserved (in lb.)	Weight of seeds recovered.		Total weight of seeds recovered (in lb.)
		Healthy (in lb.)	Diseased (in lb.)	
(1)	(2)	(3)	(4)	(5)
1 Mercury chloride 0·1 per cent for 1½ hours.	100	51	39	90
2 Agresan G. 0.25 per cent for half an hour.	100	89	2	91
3 Ceresan 0·25 per cent for half an hour.	100	90	3	93
4 Control (washed in water and air dried).	100	78¾	5	83¾
5 Control (unwashed) ..	100	69·5	10	79·5

As in previous years the treated seeds were without any shrinkage and free from scale insects with good and vigorous sprouts while the untreated control seeds were shurnken with pale and thin sprouts and infested with scale insects. This year, however, the mercuric chloride treatment compares unfavourably with Agrosan G and ceresan as soft-rot was found in this treatment to a considerable extent.

Field experiments for control of soft-rot.—Field experiments were laid out in three different localities in Malabar with the following seed treatments :—

(1) Steeping in 0·1 per cent mercuric chloride solution for 1½ hours before storage.

(2) Steeping in 0·1 per cent mercuric chloride solution for 1½ hours before planting.

(3) Steeping in 0·1 per cent mercuric chloride solution for 1½ hours before storage and again before planting.

(4) Steeping in 0·25 per cent solution of Agrosan G for half an hour before pitting.

(5) Steeping in 0·25 per cent solution of Agrosan G for half an hour before planting.

(6) Steeping in 0·25 per cent solution of Agrosan G for half an hour before storage and again before planting.

(7) Application of Nicifos at 300 lb. per acre.

(8) Spraying the beds before planting with half per cent copper sulphate solution at the rate of one gallon per square yard.

(9) Control.

The disease appeared only in a mild form in two out of the three places, where the experiment was conducted. The analysis of the results indicated the following conclusions :—

(1) The soil treatments were ineffective in controlling the disease.

(2) The two single treatments with mercuric chloride and all the three treatments with Agrosan G were the best in effectively controlling the disease and giving a good yield.

(3) Two treatments with mercuric chloride was not effective and the yield was reduced considerably.

(4) The control, the soil treatments and two treatments with mercuric chloride gave the lowest yield.

9. *Cardamom—Rhizome rot—Pythium species.*—Two species of *Phythium* were isolated from affected rhizomes. One was isolated from specimens obtained from Stanmore estate in Anamalai Hills and the other from Vellimalai estate in Palni Hills. Both the isolations are found to differ from each other considerably in their characters.

Pythium sp. from Stanmore cardamoms.—The fungus grows well in agar media producing spherical sporangia, oogonia, antheridia and oospores. Only a few sporangia could be found in agar media but when young actively growing mycelium from cornmeal agar was transferred to sterilized water in a Petri dish and kept in darkness at 20°C, large numbers of spherical sporangia were found after two days. These when kept in light for about half an hour were found to evacuate their contents into a vesicle in which zoospores were formed and subsequently liberated. The evacuation tube was usually short. Oogonia and oospores were found in large numbers in cornmeal agar tubes. The oogonia are smooth, spherical and borne on slender stalks. The oospore is also smooth with a thick wall of light brown colour. The average dieameter of the oogonium was 17·28μ with a range of 14·4 to 19·8μ. The oospore diameter was found to average 15·48μ with a range of 12·6 to 18·0μ. The ratio of oogonium to oospore diameter is 1·16. The antheridium is single, one celled, arising from adjacent hyphae or below oogonial stalk and persistent.

All the characters described above closely agree with the characters given for *Pythium complectens.*

Pythium sp. from Vellimalai cardamom.—The second isolation of Pythium is found to belong to the *gracile* group. The mycelium consists of fine hyphae. The sporangia are filamentous and indistinguishable from the ordinary hyphal. The filamentous sporangia were found to put forth evacuation tubes ending in a vesicle into

which the contents passed, the zoospore differentiation taking place in the vesicle. The evacuation tubes were much longer than in *Pythium complectens.*

10. *Redgram—Wilt—Fusarium udum var. cajani—Varietal resistance trials.*—The varietal resistance trials were continued during the year in collaboration with the Cotton Specialist in field No. 7 of the Cotton Breeding Station at Coimbatore with 73 cultures of redgram. The total stand in each row was noted after germination and prior to the appearance of disease. Soon after the disease was noticed periodic wilt counts were taken at weekly intervals. The data obtained regarding the percentage of infection in each variety were statistically analysed. The results showed that Pusa 80, Pusa 80/3, Thadagam 1/5 and Thadagam 11/41 were highly resistant to Fusarium wilt, the infection ranging only from 0 to 5·5 per cent. The other varieties showed infection ranging from 10 to 100 per cent.

11. *Groundnut—Wilt—Macrophomina phaseoli—Incidence of wilt in relation to time of sowing.*—A field experiment was laid out at Tindivanam Agricultural Research Station in collaboration with the Oil Seeds Specialist. AH. 42, a susceptible bunch variety was selected for the experiment. The first sowing was done in February. The sowings were repeated in April and May. The crops sown in February and March showed 40·7 per cent and 24·8 per cent infection, respectively, while April and May sown crops showed only a very low incidence with 5·1 per cent and 1·0 per cent, respectively, though 35·8 per cent of infection was obtained for the April sown crop during the previous year.

12. *Sugarcane—Red-rot—Colletotrichum falcatum.—Infection studies.*—The mode of infection of sugarcane was investigated by inoculation of disease-free setts of Vellai, Poovan and Co 421 in four different ways. In the first series bores were made in the internode by a sterilised cork borer, the cultures introduced in the hole, the plug replaced in the bore and covered over with molten paraffin wax. In the second series, cultures of the fungus on cornmeal-sand medium and sterilized sugarcane bits were mixed with the soil and the setts then planted. In the third series the setts were dipped in spore suspension before planting. In the fourth series, the setts were planted and the soil was watered with spore suspensions. The following table gives the results of infection obtained in each case :—

TABLE XII.—*Inoculation experiments on sugarcane with 'red-rot' fungus.*

Method of infection.	Poovan.		Vellai.		Co. 421.	
	Number of shoots.	Number infected.	Number of shoots.	Number infected.	Number of shoots.	Number infected.
Infection through bore holes	24	15	16	9	21	11
Soil infection	14	6	17	7	16	4
Dipping in spore suspension.	23	Nil.	28	Nil.	32	Nil.
Watering with spore suspension.	20	Nil.	18	Nil.	18	Nil.
Control	23	Nil.	22	Nil.	19	Nil.

The results show that the highest infection occurs when the fungus is introduced into the setts through bore holes. Planting in freshly infected soil also produces infection but to a lesser extent. Dipping in spore suspensions or watering the soil with spore suspensions did not produce any infection.

Pre-treatment with bordeaux mixture as a preventive against red-rot infection.—The experiment was conducted in large concrete troughs. The soil was first inoculated with the fungus by mixing it with sand cornmeal cultures. The setts were then planted after steeping them in 1 per cent bordeaux mixture for 5 minutes. Untreated setts were planted as controls. The following table gives the germination and infection results :—

TABLE XIII.—*Effect of pre-treatment of sugarcane setts with bordeaux mixture on red-rot infection.*

	Number of setts.	Number of shoots.	Percentage of germination.	Number of diseased shoots.	Percentage of infection.
Dipped in bordeaux mixture. ..	30	60	66·7	1	1·7
Control ..	20	37	61·7	7	19·0

The observations show that dipping the setts in bordeaux mixture reduces the amount of infection considerably though the percentage of germination was more or less the same in both cases. When the same experiment was, however, conducted in October when there was heavy rainfall after planting, there was a great difference in germination pe centage in favour of bordeaux mixture and the treated setts showed 37 percent germination against 18 per cent of the controls.

13. *Comparative studies of Colletotrichum falcatum, C. graminicolum and Colletotrichum sp. from Arundo donax.*—Cultural studies showed only slight differences between *C. falcatum* and *C. graminicolum*. The species from *Arundo donax*, however, was found to be quite distinct in morphology and physiological behaviour.

Inoculation studies showed that *C. falcatum* infects sorghum leaves but not *Arundo donax*. *C. graminicolum* infects sugarcane stem through bores made in setts or standing canes causing the reddening of tissues in the adjacent internodes also. Wounded sugarcane leaves also were readily infected producing the characteristic leaf spot symptoms while wounded leaves of *Arundo donax* failed to take infection. The isolation from *Arundo donax* was not able to infect wounded leaves and stems of standing canes. Cut canes, however, were found to get infected when inoculated through bore holes.

14. *Cotton—"black arm"—Phytomonas malvacearum—Seed treatment.*—Field experiments on the control of black arm by seed treatment with different fungicides were repeated at the Cotton Breeding Station. The various treatments used were Formalin in three forms—a steep, a spray and a dust—Ceresan Agrosan G, and N.G. 3399/9N. The experiment was laid out in randomised blocks of 15 plants each with 10 replications. The plots were examined at intervals and the incidence of disease recorded. The following table gives the course of infection at different periods :—

TABLE XIV.—*Infection of cotton black arm at different intervals.*

Date of sowing : 14–9–41.

Treatments.	14—10—41	22—10—41	28—10—41	25—11—41	23—12—41	19—1—42	Total No. of diseased plants.	Mean infection per plot.	
Formalin steep ..	..	..	1	7	13	7	28	2·8	
Do. spray ..	..	..	..	9	27	5	41	4·1	
Do. dust ..	2	..	5	9	18	2	36	3·6	
Ceresan ..	2	1	2	13	18	4	40	4·0	Critical difference 2·06
Agrosan G. ..	1	1	..	10	28	6	46	4·6	
N.G. 3399/9 N. ..	..	..	1	8	14	6	29	2·9	
Control ..	21	2	9	39	26	4	101	10·1	
Rainfall (in inches) during the period.	4·53	1·90	..	5·81	1·70	..	..	..	
Number of rainy days during the period.	9	4	..	10	5	..	..	..	

The results show that the treatments are effective in reducing primary infection. But after the plants have grown for over two months, secondary infection takes place from neighbouring infected plants. A distinct increase in the number of diseased plants was noticed soon after heavy rains or humid weather. When bright and rainless weather intervened there was again a reduction in the amount of fresh cases of secondary infection.

The strain Nyes B31 reputed to be resistant in other countries did not show infection for a month and a half even when the seed was sown without any treatment. Secondary infection, however, set in after this period and the final incidence was as heavy as some of the treated series though very much less than in the controls.

The results obtained for the seed treatments confirm the results obtained during the previous year. There is no significant differences between the various treatments except the control as regards the final incidence of disease.

Incidence of natural infection in different varieties.—All the varieties in the Cotton Breeding Station at Coimbatore were examined and the incidence of infection noted. As in the

previous year it was found that the American and Egyptian varieties were heavily infected causing the death of the plants in some cases. Among the exotics, the varieties Acala, Nysaland (Zomba, N3), Rhodesian, Anglo-Egyptian, Sudan (N.T. 18) Californian, Sea Island, Ashmouni, Sind-Egypt, Sakel and Durango showed very heavy infection. Many of the dry cottons e.g., H1, Cocanada survey types, Cernuum, Nadam, Tellapathi, C7, Verum, N14, N23 and Jayawant were free.

Cotton—Areolate mildew—Ramularia areola.—During the examination of the cotton varieties in the Cotton Breeding Station, most of the dry cottons were found to be affected with areolate mildew. The varieties K1, C7, Tellapathi, N14, E.B. 31, Abu Hareira, Roseum and Bani 306 showed heavy infection

15. *Citrus*—"*Mottle leaf*"—*Deficiency disease.*—With a view to finding out whether the disease known as 'mottle leaf' in citrus is caused by the deficiency of zinc alone or any one of the elements, copper, iron, magnesium or manganese experiments were conducted at Panyam and Kodur.

The following treatments were tried :—

Spray treatments.—

(1) Combination mixture.
(2) Zinc sulphate lime mixture.
(3) Magnesium sulphate lime mixture.
(4) Iron sulphate lime mixture.
(5) Manganese sulphate lime mixture.
(6) Copper sulphate lime mixture.

Soil applications.—

(7) Zinc sulphate at 1 lb. per tree.
(8) Magnesium sulphate at 1 lb. per tree.
(9) Iron sulphate at 1 lb. per tree.
(10) Control.

Experiments at Panyam.—Fifty trees with conditions for disease and environment as nearly equal as possible were selected and distributed among the ten treatments in randomised block arrangement. Before the treatments were applied, the selected trees were examined in detail for their condition at the beginning of the experiment. The chemicals for soil application were applied in three holes dug with a crowbar round each tree and 3 feet away from the crown of the trees. The first observation was taken after two months when the spray treatments were repeated. Records of the percentage of mottled leaves and length of internodes were recorded. From the results of the observations, the following conclusions were apparent :—

(1) Among the spray and soil treatments spray treatments have given the best results.

(2) Among the sprays zinc sulphate lime mixture stands first in the control of the disease, the next in rank being the combination mixture.

(3) The soil application has not been effective at all and the trees under this series were no better than the control.

Experiments at Kodur.—The experiments conducted here were exactly on the same lines as at Panyam. The observations made so far show similar results as at Panyam except that soil application with zinc sulphate shows signs of improvement in four out of five trees. This indicates that while the deficiency in both localities is of a similar nature, soil application of zinc sulphate is effective only under certain soil conditions. A similar experiment was started in Tanjore towards the close of the period under report.

16. *Tobacco—Broom-rape—Orobanche cernua var. desertorum.*—Broom-rapes have so far been found in Coimbatore on tobacco, brinjal, tomato, petunia and *Withania somnifera.*

Germination.—Attempts to germinate orobanche seeds under laboratory conditions were not successful. But when seeds were mixed with soil in pots and a month old seedlings of tobacco were planted the parasites appeared in about two months.

Field observations.—Observations made in fields of Virginian tobacco at Guntur showed the following :—

(1) Broom-rape infestation of the root system of tobacco in a field can be detected in the pre-emergency stage by the drooping of leaves in the afternoons.

(2) Drooping of healthy plants may be caused by the midday sun, but the effect of Orobanche could be distinguished from that caused by the heat. In the former all the leaves become flaccid as against the tender top leaves in the latter.

(3) Leaves showing drooping from physiological drought recover their turgidity earlier in the night than those of parasite infested plants.

Effect of systematic removal of parasites on yield.—An experiment was conducted to ascertain the yield of three series of tobacco plants, viz., (1) the parasites removed daily, (2) parasites removed once a fortnight, (3) apparently healthy plants. Each of these series consisted of 50 plants. The following yields of green weight of leaf and also the average height per plant were recorded :—

TABLE XV.—*Effect of broom-rapes on yield and growth of tobacco.*

	Green weight of leaf in lb.	Average height of plants in Cm.
(*a*) Broom-rapes removed daily ..	28·5	100·5
(*b*) Broom-rapes removed once a fortnight. ..	23·5	86·9
(*c*) Apparently healthy plants ..	43·75	121·9

The data obtained above show that apparently healthy plants gave the best growth and highest yield. Next in order were plants

from which broom-rapes were collected every day. Plants from which broom-rapes were collected once a fortnight gave the poorest growth and yield

Incidence of broom-rape in relation to rotation.—To ascertain the amount of infection in fields where tobacco is grown every year or once in two to seven years a survey was conducted in some villages in Guntur.

TABLE XVI.— *Incidence of broom-rape infection under different systems of rotation.*

	PER CENT.
(1) Tobacco planted for the first time ..	11·5
(2) Tobacco once in 2 years	38·5
(3) Tobacco once in 3 years	17·5
(4) Tobacco continuously for two years in a three year rotation	25·95
(5) Tobacco planted continuously for 4 to 7 years	39·6

While it is unsafe to draw definite conclusions from these observations, the figures indicate that continuous cropping of tobacco and cropping once in two years are harmful. Tobacco once in three years appears to be a more rational procedure.

17. *War effort—Ergot production—Claviceps purpurea.*—To try whether medicinal ergot can be artificially produced, cultures of the conidial stage of the fungus were obtained from the Agricultural department of Australia and also from the Sydney University. The pure culture was grown on a variety of culture media. The fungus was found to grow well on sterilized rye grains, malted sorghum and to a lesser extent in maize grains and sugarcane bits. Among agar media tried the best medium was one containing cane sugar, asparagin, potassium phosphate, magnesium sulphate and agar agar. On this medium the fungus grows luxuriantly and produces large numbers of spores. The fungus was found to favour an alkaline medium.

Two acres of rye were grown at the Nanjanad Potato Station and inoculations were carried out by spraying the ears just after emergence with spore suspensions of the fungus. The results are awaited. The possiblity of obtaining useful alkalodis by growing the fungus on a saprophytic substratum is also being explored.

II. VIRUS DISEASE INVESTIGATIONS.

1. *Sugarcane—Mosaic—Varietal resistance.*—The annual field trials to estimate the relative resistance of sugarcane varieties were continued. Eleven varieties were under trial. Periodic

counts of mosaic infection were taken for each variety. The season was found to be very unfavourable for the spread of secondary infection. Even the most susceptible Co 213 which usually shows about 75 to 100 per cent infection gave only 10 per cent infection. The only other variety to show any infection was Co. 419 (2·2 per cent).

2. *Cotton stenosis.*—The investigation of the disease was taken up at Adoni. The stenosis or sterility disease of cotton is found to be a serious menace to the *mungari* cotton crop in the Ceded districts. It affects only the indigenous types and according to the experience of the cultivators in the tract is usually severe in years when there is early rainfall and sowing.

The disease is characterised by a considerable reduction in the size of leaves, crowding of the axillary branches, modification of the calyx and corolla (phyllody) and the suppression of the androecium and gynoecium with the result that the affected plants seldom bear any normal flowers.

Preliminary trials both at Adoni and Hagari had indicated that the disease might be of virus origin as a few cases of successful transmission were obtained by grafting. With a view to ascertain the nature of the disease and possible insect vectors, if any, a series of trials were carried out at Adoni.

Cotton plants of the strain *Verum* 434 were raised in 100 pots under strictly insect-proof conditions by providing a suitable muslin cage for each pot.

Sap inoculation.—Some of the enclosed plants were inoculated by rubbing the sap from diseased plants against the leaves of the healthy. None of the inoculated plants took infection.

Grafting.—The other pots were carried to a field where the disease was present in the cotton crop. Grafting by inarching was then done between the healthy plants inside the muslin cage and the diseased plants in the field. After a month successful union was found to have taken place. The healthy plants showed signs of infection about 60 days after grafting. Out of 39 plants successfully grafted, 31 showed infection manifesting typical symptoms of stenosis. The controls which were grafted on healthy cotton plants remained free throughout. The transmissible nature of the disease was thus established for the first time.

Insect transmission.—A number of suspected insect species collected in the locality were used for transmission purposes. None of them proved to be a vector.

Incidence of infection in relation to time of sowing.—A field experiment was laid out to see if the time sowing had any effect on

the incidence of disease. Seven varieties of cotton were sown in replicated plots at three different periods—first weeks of August, September and October. Owing to the absence of heavy incidence of disease even in the susceptible varieties of the earliest sown crop, the results were not conclusive, but the foliowing indications were obtained:—

(1) Stenosis occurred in all the varieties tried.

(2) Stenosis was found in all the three different sowings.

(3) The highest incidence occurred in the first crop sown in August.

(4) Verum 434 showed the highest incidence among the seven varieties tried.

3. *Tobacco mosaic.*—A mosaic isolated from tobacco grown in the Central Farm at Coimbatore was identified by inoculation and transmission experiments to be a strain of cucumber mosaic. It produces mottling on *Nicotiana glutinosa.* The mosaic was found to be sap-transmissible and also by means of an insect vector, *Myzus persicae.*

The aphid was capable of transmitting the disease after 24 hours' feeding and symptoms developed within 10 days.

The disease is found to be transmissible to tobacco, cucumber, *Datura fastuosa* and *Nicotiana glutinosa.*

Solanum seaforthianum—Mosaic.—A strain of mosaic characterised by faint chlorotic mottling of leaves and petals of *Solanum seaforthianum* was discovered. The disease was successfully transmitted to *Solanum seaforthianum, Nicotiana glutinosa* and tobacco by sap transmission. These inoculated plants were found to produce mottling symptom. The disease failed to show symptoms on brinjal, chillies and tomato.

III.—Advisory Work.

One hundred and seven specimens of diseased plants received for examination and technical advice were attended to during the year. Besides these twenty-one enquiries relating to plant pathological problems were also dealt with.

IV.—Quarantine Service and Legislative Measures.

Seven consignments of plants or products were examined or fumigated and necessary certificates issued.

Madras Agricultural Pests and Diseases Act in respect of bud-rot of palmyra and coconut palms.—The Madras Agricultural Pests and Diseases Act of 1919 continued to be in force during the year in respect of the bud-rot disease of palmyra and coconut palms in East Godavari, West Godavari, Kistna and parts of Guntur and Malabar districts.

West Godavari.—One Tahsildar, 6 special revenue inspectors, 9 maistries and 8 peons were at work in this district for enforcing

the provisions of the Act against the bud-rot of palms. One hundred and six thousand and nine hundred and fifty-eight trees were operated during the year leaving a balance of 76,831 dead and diseased trees for further work.

East Godavari.—In this district 11 Revenue Inspectors, 15 maistries and 11 peons were at work. Fifty-two thousand and one hundred and eight dead and diseased trees were operated leaving a balance of 10,699 dead and diseased trees for further work.

Guntur (Repalle and Tenali taluks).—One Special Revenue Inspector, one peon, three maistries and four skilled labourers were in charge of the work. Up to the end March, 7,709 trees were found dead or diseased of which 3,759 were operated leaving a balance of 3,950 trees in Repalle taluk.

Malabar district (Palghat, Walluvanad and Ponnani taluks).—A Sub-Assistant in Mycology, a messenger, three maistries, one special revenue inspector and a peon were in charge of the work. Out of a total of 11,542 infected trees, 8,748 dead and diseased trees were detected during the year and 5,058 were operated leaving a balance 6,484 trees for further action.

Though the contribution of the village officers in the matter of reporting dead and diseased trees has considerably increased, a few of them still continue to send nil reports, though the Agricultural department has been able to report hundreds of cases in those places. This is specially the case in Ponnani where in seven revenue firkas only 103 cases were reported as against the 2,008 cases reported by the Agricultural department. Of these seven firkas, five had sent in nil statements.

Madras Agricultural Pests and Diseases Act in respect of mosaic disease of cardmoms.—The Act continued to be in force during the year in respect of the importation of cardamom plants, rhizomes or live plant material into the Nelliampathies in Palghat taluk of Malabar district.

Pests and Diseases Act in respect of broom-rape disease of tobacco.—The dangerous parasite of tobacco was brought under the provisions of the Pest Act in December 1941 for Guntur, East Godavari and West Godavari districts. A special staff of 8 fieldmen and 16 maistries was appointed. The work this year was mostly confined to propaganda and survey.

V.—Propaganda.

Mycological exhibits in show cases were sent to the Srirangam exhibition.

A radio talk on turmeric diseases was revised for the Agricultural Demonstrator, Karur.

Coloured posters were prepared regarding control of arecanut *mahali*, orange leaf-fall and fruit-rot and broom-rape of tobacco.

A Leaflet on broom-rape of tobacco was prepared and submitted for publication.

The Mycology and Entomology Demonstrators and the Mycology Assistants stationed in the districts attended to various calls in connection with disease outbreaks and rendered all help and demonstrated the necessary methods of control.

VI.—Teaching.

Thirty-two lectures in mycology and plant pathology were delivered to the students of B. Sc. (Ag.) III and 26 practical classes conducted. Three lectures were given and five practical classes held for the refresher course for the Agricultural demonstrators deputed for the purpose. A short course of 15 lectures and 15 practical classes was held for the students of the short course in Agriculture.

VII.—Microtomy.

The microtome section continued to serve the needs of all the sections in the institute as well as the officers in the districts. The following statement sums up the main work carried out in the section :—

Materials received	265
Materials embedded	221
Number of blocks cut	211
Number of slides prepared	1,264
Number of slides stained	1,250
Number of slides mounted	1,265

VIII.—Miscellaneous.

Supply of cultures and specimen.—(1) Cultures of *Collectotrichum falcatum* and *Piricularia oryzae* were supplied to the Agricultural Institute, Allahabad.

(2) The plus-and-minus strains of *Rhizopus nigricans* were supplied to Dr. Ekambaram, Presidency College, Madras.

(3) A culture of *Fusarium moniliforme* var. *majus* was supplied to the Assistant Mycologist, Sind.

(4) Five specimens of fungus diseases were supplied to the Government Victoria College, Palghat.

Publications.—The following papers were published :—

(1) A Note on top-rot of Sugarcane, Sorghum and Cumbu by T. S. Ramakrishnan (*Current Science*).

(2) A Leaf Spot Disease of *Zingiber officinale* caused by *Phyllosticta zingiberi* by T. S. Ramakrishnan. (*Proceedings of the Indian Academy of Sciences*).

(3) Broom-rape of tobacco by K. M. Thomas (*Villagers' Guide and Calendar*).

Coimbatore,

K. M. THOMAS,
Government Mycologist.

DETAILED ADMINISTRATION REPORT OF THE GOVERNMENT ENTOMOLOGIST, COIMBATORE, FOR THE YEAR 1941-42.

I.—General.

I beg to submit the following report on the activities of the Entomological section for the year ending 30th June 1942.

II.—Charge.

I continued to be in charge of the section as Entomologist.

III —Advisory.

Nine hundred and seventy-nine enquiries were received from different parts of the Presidency and suitable advice was given wherever necessary. Of these, 247 where received at headquarters and the rest by the Entomological and Mycological staff stationed in the districts under the administrative control of the District Agricultural officers. Most of the reports related to control of crop pests and bee-keeping.

IV.—Teaching.

During the year under review the following lectures and practical classes were held :—

Class.	*Lectures.*	*Practical.*
B.Sc. (Ag.) first year	57	28
B.Sc. (Ag.) second year	28	29
Short course in insect pests	16	16
Short course in bee-keeping	15	15

In addition to these, a few lectures on the control of crop pests and beekeeping were given to the 40 agricultural demonstrators who attended the refresher course in October 1941.

V.—Special Investigations on Crop Pests.

Pests of cotton.

(1) *The cotton bollworms* (*Earias spp. and Platyedra gossypiella*) *Incidence in standing bolls of* (*a*) *Irrigated Cambodia.*—The incidence of the spotted bollworms in July and August was light and ranged from 2 per cent to 2·7 per cent while that of the pink bollworm was most pronounced with 92·5 per cent and 83·9 per cent, respectively. Pink bollworm populations stood at 265 and 258 per 100 bolls in July and August, respectively.

(*b*) *Rainfed cottons.*—The incidence was characterized by a higher infestation of the spotted bollworms and lower infestation of the pink bollworm as compared with that of the irrigated cottons. Infestation of *Earias* ranged from 6·6 per cent to 17·9 per cent from July to October while that of Platyedra varied from 32·4 per cent to 87·6 per cent over the same period. The population index of the latter was found to be 114 per 100 bolls.

(*c*) *Different varieties.*—The indence of the pink bollworm for July and August in the five groups made up of a total of 267 varieties and comprising of both the irrigated and rainfed types, is as under: (i) *Gissypoum herbaceum*—28 per cent; (ii) *G. arboreum*—33 per cent; (iii) *G. hirsutum*—57 per cent; (iv) *G. barbodense*—60 per cent; and (v) *G. religiosum*—67 per cent. Trends were observable of the prevalence of a comparatively higher incidence in the irrigated types than in the rainfed ones as indicated by the percentages of the first two as against the rest.

(*d*) *Alternate host plants.*—Incidence of the spotted bollworms for four months from July ranged from 7·1 per cent to 31·5 per cent in October in *Hibiscus esculentus* and from 3·6 per cent to 22·5 per cent in *Abutilon* spp. Rise in incidence followed by a fall and a subsquent rise was found to be the feature in both the cases.

Habits of the pinkbollworms.—Nature and extent of pupation of the above caterpillars was determined in bolls placed on the soil. Fifty per cent of the larvae had pupated within the bolls; of these, 69 per cent pupated in seeds and the rest in the lint. Of those that pupated outside the bolls, 46 per cent were found in the soil distributed in the top one inch layer while the rest pupated on the soil.

Larval diapause.—Larval diapaus (resting stage) was found to exist even in larvae collected from May to August. The resting larvae were found both in the seed and lint. The duration of the diapause period was found to be 91–119 days in July material and 72–142 days in August material.

Incidence of bollworm parasites.—The spotted bollworms in cotton were found parasitised by *Rhogas aligarhensi*, *Microbracon lefroyi* and *Bassus* sp. in the early stages; the former was most pronounced in October and as higher as 42 per cent of the larve were found parasitised by *Rhogas*. For the first time hyper-parasitisation by chalcids was noted in *Rhogas* pupae. *Microbracon greeni* and *Elasmus johnstoni* were the parasites affecting the larvae in *Hibiseus vitifolius*; the latter was most pronounced in July. *Microbracon gelechidiphagus* emerged in large numbers from pink bollworms towards the end of August.

Trial with Trichogramm a parasites against bollworm.—Laboratory studies have indicated that fecundity of a single female was about 125 eggs spread over 11 days with an average of 11 eggs per day and total emergence of parasites was over in two days. Field trials consisted of large scale liberation of *Trichogramma* parasites at periodical intervals. Eighteen liberations were made in four fields from the middle of December to the end of February at 10,000 parasies per liberation per acre. Burst bolls from the treated and control plots were examined for bollworm incidence. Trends of reduction in the bollworm incidence were noticeable in the released plots.

(2) The cotton stem weevil *Pempherulus affinis incidence in cotton.*—The incidence of the weevil in the seasonal crop has been rather heavy even in October indicating that the first wave of influx of weevils was quick and severe. A cent per cent infestation was recorded in February though live population showed a slight fall. After this period the population has shown a rapid decline.

Incidence in host plants.—Of the ten different species of plants examined for incidence, only five of them showed infestation of the pest in varying degree. The infestation is as follows: *Triumfetta rhomboidea*—70·2 percent; *Hibiscus ficulnens*—25·0 per cent; *H. vitifolius*—12·5 per cent *Sida acuta*—4·4 per cent; and *Malvastrum coromandelianum*—2·3 per cent.

Occurrence of biological races.—Due to limited facility available for rearing out the adults from different host plants, those from *Triumfetta* alone were reared out to adults and their performance on cotton studied. The adults failed to oviposit on cotton in cages. More intensive trials are necessary before they could be regarded as a different strain of the weevil.

Incidence of parasitism.—Parasitism was low both in the alternate host plants and cotton. The occurrence of *Dinarmus* on the grubs in cotton—a feature that was not known before, is significant and suggests that it is possible for the parasite present in wild plants to attack the weevil in cotton plants.

Mass multiplication of the parasites.—Unusually this year, bostrychid infestation of the cotton stalks was practically absent and hence an initial stock of parasites from bostrychids could not be obtained. The work had, therefore, to be deferred.

(3) *The cotton leaf roller (Sylepta derogata)—Incidence of the pest and its parasites.*—Incidence of the pest was determined in Cambodia crop sown in September. It was fairly high at the end of November and the peak of 100 per cent was reached in January. The pest was not in evidence after February. Incidence of the pest is given below:—

Month.	Percentage of plants attacked.	Percentage of leaves damaged.	Average live stages per 100 plants.
November 1941	78·5	16·8	308
December 1941	92·3	18·2	966
January 1942	100·0	30·4	710
February 1942	88·4	14·7	2·3

Two species of *Apanteles*, *Microbracon sp.*, *Elasmus brevicornis* and *E. sp.* were noted on larvae, *Brachymeria sp.* and *Xanthopimpla* on pupae and *Trichogramma sp.* on eggs of the host in the field. The good effect of the parasites was in some measure vitiated by the appearance of four species of secondary parasites. They consisted of *Eurytoma*, *Pleurotropis*, *Elasmus* and *Proctotrupid* species. First signs of parasitism were seen in late October and a

rapid rise in incidence of parasitism was noted thereafter; the maximum of 64·6 per cent being reached in January. The incidence trends of the parasites appear to follow closely that of the host. Percentage of primary parasitism increases by the end of first generation and attains the maximum during the second generation when hyper-parasitism sets in and brings about a decline in the number of primary parasites.

Alternate host plants.—*Hibiscus esculentus* and *Althoea rosea* were found heavily infested. A few *Elasmus* parasites were recovered from the larvae.

Pests of Sugarcane.

The Sugarcane borers (*Argyria*, *Diatraea scirpophaga*) *—Borer survey in the Gudiyatham region* (Indian Council of Agricultural Research scheme).—Borer survey was continued for a period of five months from July to November when the scheme was finally closed down. Of the three borers noted in the region, *Argyria sticticraspis* was the most predominant. Though it is essentially a pest of young canes, it was also observed in mature canes. Highest incidence of 10·24 per cent for *Argyria sticticraspis* was recorded in July. For the other two borers it was 3·76 per cent in September for *scirpophaga* and 3·19 per cent in November for *Diatraea venosata*. The following were the parasites noted during the period:—*stenobracon deesae*, Cam, *Apanteles flavipes*, Cam, *Rhaconotus scirpophaga*, Wlk and *Elasmus zehntneri* Ferr.

Observations made on the influence of cultural methods on the incidence of borers have indicated in broad outline that (1) canes planted late in the season show more attack by *A. sticticraspis* than the early planted ones, and (2) restricted irrigation increases the incidence of the above borer. From the data gathered on the influence of weather conditions on the borer population a few broad conclusions are possible to be made. A low relative humidity, high temperature and limited rainfall would appear to favour an increase in the population of *Argyria sticticraspis*. An increase in the population of *D. venosata* and *scirpophaga* is noticeable when reverse weather conditions obtain.

A few of the cholam plants examined showed *Argyria* caterpillars.

Borer investigation at Coimbatore—(Indian Council of Agricultural Research scheme).—The investigation was started in May. Fortnightly examinations for borer incidence in three select varieties, i.e., Co. 413, Co. 419 and Co. 421 raised in replicated plots were made. Incidence of *Argyria* was very pronounced and as high as 39·9 per cent infestation was recorded in June. Infestation by *Scirpophaga* was poor and that by *Diatraea* was practically nil. Field parasitization of *Argyria* egg masses by *Trichogramma* and *Telenomus* was observed in June. Of a few other host plants examined for borer incidence *Saccharum spontaneum* alone showed infestation by *Scirpophaga* right through the period.

Trichogramma colonization experiments at Nellikuppam.—The scheme started functioning from June. Preliminaries like the laying out of plots, taking of egg counts, borer counts and density of shoots were made in accordance with the instructions given in the scheme.

Mass breeding of *Trichogramma* parasites for liberation into the experimental plots, however, is being carried out at the Research Institute, Coimbatore, where facilities exist for this kind of work.

Pests of Chillies.

The chillies thrips (*scirtothrips dorselis—Varietal resistance studies.*—Forty varieties of chillies were tested for resistance to thrips in five replicated blocks. No insecticidal treatment was given to the plants either in the nursery beds or in the planted field. Season was good from the commencement upto the middle and leaf curls were scarce. The crop, however, received a set-back in November due to precipitation being in excess and soil being rather heavy. Leaf curls became prominent thereafter and appreciable rise in population of thrips was noted in January. Trends of thrips population were noted to take more or less an identical course as that of the last year excepting for the fact that the initial population was unusually low. Varieties were found significant both for low populations of thrips and yield at 1 per cent level of probability against the standard (local gundu). Varieties like Ambasamudram (Nattuvattal), Papanasam, I.P. 5., Erode samba, Tirumangalam and Kathiawar were resistant. Tiruchendur was the heaviest yielder giving an increase of 40 per cent yield over and above the standard. The latter appears to be a variety exhibiting extreme degree of tolerance to heavy thrips infestation.

Pests of Paddy.

(1) *The paddy stem borer* (*Schoenobius incertellus*).—Light trapping experiments were continued for the third year in succession for the second crop paddy in two different plots at Vadavanur, Palghat taluk using petromax and hurricane lights. The moth catches recorded for petromax and hurricane were 44,286 and 14,962, respectively, for 126 and 128 days of three burning hours each. Stem borer incidence at the ear-head stage was determined by taking counts of the chaffy ear-heads. Average infestation percentages for petromax and its control were 0·65 per cent and 5·56 per cent with a difference of 4·85 per cent in its favour whereas they were 1·48 per cent and 4·31 per cent with a difference of 2·83 per cent in favour of the hurricane light. The maximum infestation percentages for petromax and its control were 1·8 per cent and 11·59 per cent whereas they were 1·48 per cent and 4·31 per cent for hurricane light and its control. The cost of working the trap with a hurricane light works out to Rs. 3 for 126 lighting days.

(2) *The paddy ear-head bug* (*Leptocorisa acuta*).—Varietal resistance to paddy ear-head bug attack was determined by estimating the damage caused to the paddy grains from samples of 100 ear-heads each, drawn at random from 50 varieties grown at the Paddy Breeding Station. Amongst the two lots that flushed in different periods, Ptb. 5 recorded least damage of 15 per cent amongst the 19 varieties that flowered in September while Co. 19 gave 6·88 per cent among those that flowered from November onwards.

(3) *The paddy mealy bug* (*Ripersia oryzae*).—Incidence of the pest in general was most pronounced in 'Kuruvai' crops and less so in 'Thaladi' or 'Samba' crops. The maximum infestations in the three crops were as follows: Kuruvai Adt. 18, 32·3 per cent; Samba Adt. 11, 47·4 per cent; Thaladi Adt. 11 and Adt. 17, 3·44 per cent. The infestation of the bug was found to extend up to a distance of 8 feet from the bund in the nursery beds.

In addition to *Cyperus rotundus* the grass weed *Chloris barbata* was found infested heavily with the bug in the off-season. Scorching of the nursery bunds prior to sowing of kuruvai and planting out the seedlings therein as a measure of control of the pest appear to hold out promise. The infestation averages in the treated and control areas are given below:—

Crop.	Treated.	Control.
	PER CENT	PER CENT
Udu (Kuruvai) July 1941 ..	0·47	6·00
Ottadan January 1942 ..	0·26	2·35

Experiments have been laid out at Aduturai to test the efficacy of the scorching of the nursery bunds on a large scale. Intermittent irrigation (5 days wet and 2 days dry) practices in Pattukkottai as an anti-malarial measure does not appear to increase 'soorai' infestation as is probably believed. On the other hand, the trends point to an increased infestation in the normal irrigation plots. In one of the villages the incidence in the samba crop in intermittent and normal irrigation fields was 3·12 per cent and 4 9 per cent, respectively; in another village it was 6·5 per cent and 9·12 per cent, respectively.

Pests of Fruit Trees.

(1) *The apple woolly aphis* (*Eriosoma lanigera*).—At the Pomological Station, Coonoor, breeding and liberation of the parasite—*Aphelinus mali*—were continued. In January the percentage of parasitization was as high as 82 5 per cent. A steady increase in the parasitization of the aphids was noted and consequently reduction of the pest observed.

(2) *The mango blossom hopper* (*Idiocerus spp.*).—Experimental trials to test the efficacy of sulphur for the con rol of hoppers could not be made this season due to sulphur being not made

available in time. Nevertheless, from the observational tests made in February, dusting of sulphur was effective against the hopper and gave a high setting fruits. There are indications to show that it does not interfere with normal setting. Untreated trees have uniformly failed to give as good a setting as the dusted trees. The table below gives the fruits harvested in the treated and untreated trees :—

Number and variety.	Sulphur treatment.	Control.
1 Mulgoa	125	..
2 Naduchalai	450	176
3 Do.	252	67

(3) *The citrus leaf miner* (*Phyllocnistis citrella*).—Infestation by the leaf miner was noticeable quite early within a week after the new sprouts had begun to open out. The pest mined both the surfaces of leaves and caused distortion. Incidence appeared to be severe in February and March and thereafter it was less. Spraying trials with tobacco decoction and Thevetia extracts are in progress. Both the caterpillars and pupae were subject to field parasitization by different species of chalcid flies.

(4) *The citrus fruit sucking moth* (*Ophideres spp.*).—Trials with tomato as a trap crop were made. Seasonal conditions being bad, the growth and the fruiting of tomato crops were delayed in centres like Cuddapah, Vellore, Wynaad, Tindivanam, etc. Consequently the fruiting season of tomato and citrus did not synchronise and hence further trials are necessary to prove the efficacy of trapping.

Pests of Groundnut.

The groundnut ' Surul ' (*Stomopteryx nerteria*) *Varietal resistance trials.*—No statistical significance was obtained in 35 varieties of both the spreading and bunch varieties tested for resistance presumably due to the low incidence of the pest consequent on the receipt of good rains during the crop period.

Light trap trials.—Catches of moth for a hurricane light trap set up throughout the year are as follows :—

July 7,444 ; August 2,129 ; September 5,890 ; October 6,956 ; November 8,899 ; December 735 ; January 1942 26 : February 35 ; March 3 ; and April 4. As judged from catches of moths the incidence of the pest must be regarded as very low when compared with that of the previous season. For very much the same reason the experiments which were carried out to determine the effective range of the light trap did not give tangible results.

Pests of Gingelly.

The gingelly caterpillar (*Antigastra catalaunalis*) *Varietal resistance trials.*—Studies made on the varietal resistance have once again confirmed that S.I. 882 and S.I. 877 were highly resistant while S.I 6·33- was the most susceptible to caterpillar attack

in the cold weather. S.I. 882 and S.I. 877 continued to show up their resistance in the summer crop as well while S.I. 6-2-133-1 was characterized by marked susceptibility.

Study of parasites.—A predatory bug *Rhinoco is fuscipennis* and five parasites were found attacking different stages of the pest. *Microbracon hebetor* and *Angitia* were found in larger numbers than the rest.

Control with insecticides —Spraying and dusting trials against the gingelly caterpillar pest were made using thevetia kernel extracts and calcium arsenate dusts in different proportions. Damage was estimated by taking counts of affected leaves from 25 plants each in 20 replications. There are trends to show that *Thevetia* is able to reduce the damage to leaves when sprayed at a strength of 3 oz. in 10 gallons of water. Trials made this season using the most susceptible variety S.I. 6-2-133-1 indicate that trends of reduced damage are observable in the case of *Thevetia* and *groundnut oil* sprays used at strengths of $\frac{1}{2}$ oz. and 1 oz., respectively in one gallon of water.

Pests of Castor.

The Castor semilooper (*Achaea janata*).—Egg, larval and pupal periods were found to be 3 days, 9–13 days and 10–13 days, respectively. The total life cycle ranged from 22 to 28 days. No long cycle pupal stage appears to be present as the pupae left in the field cage have mostly transformed into adults while a few were destroyed by a mould fungus.

Parasites.—The following larval parasites have been collected—*Rhogas percurrens, Euplectrus leucostomus, Microplitis ophiusae, Henicospilus sp.* and *Zamesochorus orientalis.* A species of *Trichogramma* has been found to parasitize the eggs in the field. This has been noted for the first time.

Pests of Cholam.

Freckled yellow disease of cholam (*Peregrinus maidis*).—Experiments involving the use of different border crops for the control of the above disease transmitted by *Peregrinus maidis* were repeated for the third time. Redgram, lablab, talaivirichan and periamanjal cholam were raised as border crops. The incidence of the disease as determined by the four counts taken at periodical intervals was found to vary from nil to 4·6 per cent. The low percentage is attributable to the very mild incidence of the disease which was found to be a feature for the past three years in succession.

Pests of Coconut.

The Coconut beetle (*Uryctes rhinoceros*) *Biological control.*—Studies on the green muscardine fungus parasitic on the beetle grubs were continued. The activity of the fungus was most pronounced in the manure stocked in protected pits of about 1 to $1\frac{1}{2}$ feet depth. Due to failure of previous trials on the west coast the pits therein were

remodelled to the above dimensions and fresh inoculations of the fungus were made in January. Infection of the grubs both in the pitted and potted manure at one of the stations has recently been recorded. Viability of the fungus has been found to exceed 35 months.

Pests of Cardamoms.

The cardamom thrips (*Taeniothrips cardamomi*).—(1) Experiments were repeated at Korangumudi estate, Anamalais, this season restricting the insecticidal treatment to tobacco decoction spraying, on a paired plot lay out with 12 replications. The extent of scabbiness of the respective treatments was estimated by examination of the cured capsules of all the four pickings. A very high significance for good pods that were totally free from scabs, was established for the second picking only. The significance of the second picking was so high that it continued to show up when all pickings were pooled. Trends for significance closely followed that of the previous year. Earlier rounds of spraying are indicated if a higher percentage of good capsules are desired in the first picking.

(2) *The cardamom root borer.*—A moth borer caterpillar was found to cause appreciable damage to fresh growing roots at Korangumudi estate. The incidence of the pest was high in the months of July and August ; as high as 40 per cent to 50 per cent of the roots were found severely damaged The caterpillar is an internal borer and starts tunnelling down the root from the apex to the base of the rhizome. Chalcid parasites have been noted attacking the larvae.

Pests of Wattles.

The fluted scale (*Icerya purchasi*).—A serious outbreak of the fluted scale was reported on wattles in the forest wattle plantation at Baikee and Avalanche in the Nilgiris in May last. The pest appears to be slowly extending to new areas in the Nilgiris. At Kodaikanal, Ma hurai, where the pest was first observed in June 1941 on wattles, the scale is observed to be spreading to new areas. *Helichrysum bracteatum*, *Hypericum mysorense* and a few citrus trees in an orchard have been found infected. Government have ordered the enforcement of the Agricultural Pests and Diseases Act of 1919 in respect of the scale in the Upper Pulneys. A station for breeding the predatory beetle *Rodolia cardinalis* to check the fluted scale was recently established at Kodaikanal and work is in progress.

Pests of Stored Products.

The cholam pests (*Calandra oryzae*).—Experiments conducted on the storage of cholam grains with ten treatments including the control have been concluded. Of the nine treatments tested for the prevention of infestation by weevil, Acorus, monthly and quarterly dryings alone have given encouraging results Percentage of loss of grain was lowest in Acorus (3·20 per cent) while it was 7·90 per cent for the monthly drying and 14·77 per cent for the quarterly drying. A new set of experiments on much the

same lines with only seven treatments was started and is in progress. The seven treatments are (1) Acorus, (2) Slaked lime, (3) Slaked lime plus creosote, (4) Wood ash, (5) Pyrethrum, (6) quarterly drying and (7) control. Treatments are tested in bags of 25 lb. of grains each with the addition of ½ lb. of the appropriate chemical to each bag and are replicated four times. Beetle infestation is found to be the least in lime plus creosote and Acorus bags so far. Trials made to test the relative susceptibility of seven selections of cholam grains—As. 389, As 732, As. 837, As. 841, As. 1543, As. 1575 and As. 2095 to weevil attack have indicated that (1) no selection was free from attack, (2) that loss in weight due to weevil damage was appreciable in all cases; the loss ranged from 19 per cent to 32·25 per cent and (3) that selection 1575 was the least infested and the loss therein was the lowest.

VI.—Studies on Insecticides.

(*a*) *Indigenous* —Considerable progress was made in the study of indigenous insecticides. Detailed trials on the insecticidal properties of *Thevetia neriifolia* have shown that aqueous infusions of kernels are very effective as a contact poison. The effect of different strengths of this infusion on various crop pests was studied. Addition of soap in equal quantities was found to enhance the killing power of the insecticide. A strengh of ¼ oz. of the kernels with the addition of ¼ oz. of soap in one gallon of water was very effective against sucking insects such as plant lice. Against biting insects such as caterpillars, grubs, etc., ½ oz. of the kernel in one gallon of water with the addition of soap has given satisfactory results. For mealy bugs and scale insects, a strength of 1 oz. in one gallon of water was found necessary. In the case of certain insects, the insecticide has also a repellant action. The seeds stored even for ten months did not lose their vitality and the biological tests conducted did not show any appreciable variation in toxicity. Thevetia oil was found as a deterrent against termites. The trials made so far have shown that we have in *Thevetia neriifolia* a very effective and cheap contact insecticide for sucking as well as biting insects.

Acorus calamus is yet another indigenous plant whose underground rhizomes were found to possess appreciable insecticidal properties. Rzihomes were tested both as a dust and as aqueous extracts against a few well-known pests and effective control was obtained in each case. Dusts were prepared from dried rhizomes by grinding them to fine powder after they were sliced to small bits and used as such against bird lice with satisfactory results. Aqueous extracts prepared in the proportion of ½ oz. rhizomes to one gallon of water (0·3 per cent) with an addition of an equal quantity of soap when tested on cowpea aphis (*Aphis medicagenis*) and curry leaf psyllid, gave marked control of the pests. Further trials are in progress.

Laboratory trials with vegetable oil emulsions prepared from the local oils like that of groundnut, gingelly, coconut, neem and tobacco, at strengths of ½ oz. (0·3 per cent) in one gallon of water gave effective control of the plant lice (*Aphis medicagenis*) and moringa caterpillar. It would appear that these oil emulsions may ultimately prove useful in the control of a wide range of pests on a field scale and trials are in progress to determine their utility in this direction.

(*b*) *Exotic.*—Studies on Pyrethrum (*Chrysanthemum cinerariifolium*), *Tephrosia vogelli*, *T. purpurea* and *Derris elliptica* were continued. The first named is well-known as an insecticide. Attempts are being made to grow the plant on a commercial scale in the Nilgiris. Powder prepared from flowers collected from a local crop in the Nilgiris when tested for their insecticidal efficiency was found to be on a par with the imported material. A high kill was obtained in the case of *Eupterote* caterpillars and *Cootosoma* bugs when they were dusted. Two trials with the aqueous extract prepared at a strength of 1 oz. in one gallon of water gave 77·6 per cent and 87·9 per cent control of cotton aphis when sprayed with the addition of an equal quantity of soap. From trials made with cold aqueous extracts of the seeds of *Tephrosia vogelli* against divers insects like caterpillars, aphids and mealy bugs; a concentration of 1 oz. of seed in one gallon of water with a soaking of 24 hours duration was found to give a high percentage of mortality among the treated insects. Toxic efficiency of the leaf dusts was not however so marked; only 70 per cent kill of cotton aphids and 14 per cent of mealy bugs were possible to be obtained. Dusts of *D. elliptica* prepared from dried roots when used with and without diluents like flour, gave a very high percentage of kill of aphids on bhindi. Addition of diluents in equal proportions does not appear to bring down the toxic value of the mixture to any appreciable extent.

(*c*) *Fumigation trials.*—The optimum dose for securing the maximum lethal effect on adults of *Calandra oryzae* was determined to be half an ounce of Carbon di-sulphide for 15 cubic feet with an exposure of 12 hours. The dose usually adopted in conformity with the standard practice for such fumigations is 1 ounce for 15 cubic feet with an exposure of 24 hours. It would now appear that it is possible to obtain the same measure of success with the use of half the strength and half the period of exposure that were being used before.

VII—Life History Studies and Pest Control Work at Headquarters.

The following are the more important insects whose life histories have been studied :—

(1) The mango shoot webber (*Orthaga exvinaceae*).

(2) The lucerne caterpillar (*Dichomeres ianthes*) and its natural enemies.

(3) *Telenomous sp.*—an egg parasite of *Argyria sticticraspis.*

(4) The castor semilooper and its parasites.

(5) *Aphelinus sp.*—a parasite of aphids affecting different crops.

(6) Parasites of the paddy skipper (*Parnara mathias*).

(7) *Microbracon brevicornis*—a parasite of *Corcyra cephalonica.*

(8) The cotton leaf roller and its parasites.

(9) The groundnut store beetle (*Dermestes cadaverinus*).

Pest control work carried out at headquarters was in response to calls received from the Central Farm, the breeding stations and villages round about. The more important pests which received attention were paddy thrips, *Pericallia* and aphids on lablab, *Lecanium* on sapota, croton mealy bugs, mango stem borer and the mango slug (*Parasa*).

VIII.—Bee-keeping.

Research.—Research on various aspects of bee-keeping was continued. Detailed trials with the honey extractor designed by the section for the extraction of rock bee honey have been carried out with satisfactory results. Another item of research was the improvement of the Indian bee by selection. Out of the ten colonies selected for their good performance during the previous season, eight continue to keep up their strength. Trials to cross the hill with the plains variety have not been successful so far. Studies on the control of bee enemies were continued. A submersion of infested super combs in water for two hours killed the caterpillars of the wax moth. Water is expelled from the combs by means of the extractor and the combs returned to the hive. Studies on the longevity and flight range of the worker bees have been started. The newly emerged bees are marked and returned back to the colony. In March-April 1942, the maximum longevity of a worker was found to be 47 days; outdoor activity commenced on the 16th day. Bees were found visiting *Morinda tinitoria* for pollen in March.

Propaganda —Intensive propaganda was done to popularize beekeeping as a cottage industry. Bee exhibits were a special feature of most of the exhibitions and fairs. Agricultural requisites such as foundation combs, bee escapes, drone traps and dummy boards were supplied. There was a keen demand for departmental publications on bee-keeping. In addition to the short course held in February, training was given to 80 students of Government Lower Secondary Training School, Coimbatore, 40 agricultural demonstrators who attended the refresher course and four demonstration maistries. The Annual Honey Week was celebrated throughout the Presidency in March. The function at Coimbatore was inaugurated by Mrs. A.D. Crombie at the Union High School in the presence of a large gathering of ladies and gentlemen. There was a bee exhibition in connexion with the

celebrations and a few amateur bee-keepers exhibited their hives and honey. As a result of the propaganda done by the department, there was an increase of 1531 hives in the Presidency during the year under review, the total number being 7,530.

Apiary.—The apiary attached to the insectary was a centre of attraction to numerous visitors. An average strength of 40 colonies was kept for experimental and demonstration purposes. The weather and pasturage conditions were not quite favourable from July to October. From November onwards, however, the conditions were satisfactory and there was brisk brood rearing and consequent collection of nectar. The maximum record of honey for a single hive was 10 lb. 10 oz. as against 8 lb. 4 oz. of the previous year.

IX.—Quarantine Service.

During the year under review, 23 lots received for despatch to countries outside India and those imported into India from abroad were examined for pests. fumigated where necessary and pest-free certificates issued. The lots received included samples of seeds, bulbs, live plants, etc. The laboratory of the Cotton Specialist was fumigated with calcium cyanide.

X.—Systematics.

Systematic studies on hymenopterous parasites, thysanoptera and termites were continued. Intensive work was done on the former group and a paper published. No foreign sendings of insect material were possible due to war conditions. Sendings were confined to inland. Of the two consignments of insects sent to the Imperial Entomologist, New Delhi, for identification, one was received back duly named. Specimens of *Amyosoma chilonis* were sent to the United Provinces Entomologist at his request for his collections. Insects sent by different parties were determined. Specimens in the general collections belonging to order Coleoptera were sorted out into families.

XI.—Propaganda and Campaigns.

Work under propaganda and campaigns chiefly consisted of demonstration of remedial measures against insect pests and popularization of the bee-keeping industry In addition the staff were in charge of Pest Act operations and participated in the exhibitions. As time permitted, problems local to the tract received special attention. A brief account of the work done by the staff under this head is given below:—

Visakhapatnam.—The groundnut hairy caterpillar, the citrus fruit sucking moth, the paddy stem borer, the paddy gall fly, the paddy case worm, the mango mealy bug and the brinjal epilachna were some of the pests tackled by the Entomological Assistant.

East and West Godavari.—Bee-keeping industry has received great impetus in this centre and there are 1,200 hives to date in the two districts. The present position of this industry is mainly

due to the good work done by the Assistant at Samalkot. The paddy caseworm, the paddy swarming caterpillar, the rice hispa, silver shoot of paddy, *Prodenia* and aphids on tobacco, *Laphygma* on onions, the coconut beetle, the coconut caterpillar, the coconut slug (*Natada*), the mango hopper, the citrus arbelid, the chillies thrips and the brinjal epilachna were a few of the important pests for which remedial measure were suggested and demonstrations conducted.

Krishna and Guntur.—The Mycology Assistant at Masulipatnam attended to the following pests: the mango stem borer, the fruit-sucking moth, the paddy hispa, the paddy leaf roller and epilachna and *Aulacophora* on vegetables.

Cuddapah and Kurnool.—The groundnut hairy caterpillar, the mango stem borer, citrus *Arbela*, the chillies thrips, thrips on grapevine, aphis on melons, *Epilachna*, lacewing and aphis on brinjal and *Stemoxys* fly infesting cattle were some of the pests dealt with by the Entomological Assistant at Cuddapah.

Nellore and Chittoor.—The following pests were tackled by the Entomological Assistant at Nellore: paddy stem borer, paddy swarming caterpillar, the rice hispa, the paddy leaf roller, the paddy green spotted jassid, the paddy mealy bug, the paddy gall fly, the cholam stem borer, the castor semilooper, chillies, thrips, *Epilachna* on brinjal, *Prodenia* on tomato and fruit-sucking moths and mites on citrus.

Bellary and Anantapur.—Some of the pests like the citrus butterfly, chillies thrips, *Laphygma* on ragi, the jasmine bug, the mango hopper, pomegranate borer, brinjal lacewing, sunnhemp caterpillar, the Deccan grasshopper were tackled by the Mycology Assistant at Bellary.

Madras and Chingleput.—The Entomology and Mycology Demonstrators stationed at Saidapet were engaged in popularizing beekeeping in addition to attending to pest control work. The citrus butterfly, the mango hoppers, the mango stem borer, the coconut beetle, the coconut caterpillar, the paddy stem borer, the paddy caseworm, the paddy leaf roller, the jasmine bug, the sunnhemp flea beetle, aphids on lablab, *Epilachna*, lacewing and aphids on brinjal and Prodenia on tomato were the more important pests that received their attention.

South Arcot and Tanjore.—The Mycology Demonstrator at Cuddalore was engaged in the demonstration of control measures against the following pests, the agathi weevil, the paddy stem borer, the climbing cutworm of paddy, the paddy leaf roller, the paddy mealy bug, rats infesting paddy crop, ragi thrips and croton mealy bugs.

Tiruchirappalli and Mathurai.—In addition to bee-keeping and passing of cardamon samples as free from pests and diseases for export purposes, the Mycology Demonstrator at Mathurai, attended

to the following pests, groundnut hairy caterpillar, grapevine flea beetle, citrus butterfly aphids on citrus and the paddy earhead bug.

Ramnad and Tirunelveli.—The Entomology Assistant at Tirunelveli was able to tackle the following pests, the mango stem borer, the coconut caterpillar, the paddy mealy bug, the paddy borer, the paddy swarming caterpillar, rats infesting paddy fields, sunnhemp hairy caterpillar, chillies thrips, Acherontia styx on field beans and Epilachna and lacewing on brinjal in addition to popularising beekeeping.

North Arcot and Salem.—Paddy swarming caterpillar, paddy stem borer, groundnut hairy caterpillar, coconut caterpillar, grapevine flea beetle, mango hopper, Chrysanthemum caterpillar (*Lamprosema*), Chloridea on tomato fruits, aphids on citrus, chillies thrips, Epilachna on brinjals and potatoes were some of the pests which received the attention of the Entomology Assistant at Vellore. He was also engaged in popularizing bee-keeping.

Malabar and South Kanara.—In addition to bee-keeping, the Mycology Demonstrator was engaged in rearing parasites for the control of the coconut caterpillar. He also attended to the mango hopper and pests of paddy such as stem borer, Hispa, Leptispa, caseworm and rice bug.

Coimbatore and the Nilgiris.—The headquarters staff, in addition to being fully engaged in problems of special investigation at the Research Institute and elsewhere, have been able to attend to the needs of these two districts. The noteworthy pests tackled were—mealy bugs on arecanut mealy bugs on brinjal, chillies thrips, gingelly shoot caterpillar and pod fly, coconut cater pillar, castor mite, aphids on lablab, the tea mosquito on guava, thrips on paddy and the paddy stem borer. Supply of show cases of insects, bromide enlargements, dusting and spraying appliances insecticides, bee-keeping appliances and exhibit for shows and exhibitions formed a special feature of the work of the section at the Research Institute, Coimbatore.

XII.—Scientific Papers Prepared.

The following papers were prepared during the year:—

(1) Studies on *Stomopteryx nerteria* Meyr—a pest of groundnut in the Madras Presidency.

(2) Bionomics and Control of *Nephopteryx eugraphella*—Pyralid pest of sapota.

(3) Studies on *Platyedra gossypiella* Saunders—the pink bollworm of cotton in South India.

(4) *Thevetia nerifolia* Juss—a source of an efficient insecticide.

(5) Notes on some insect parasites of economic importance in the Madras Presidency.

(6) Biology of a new Ichneumonid parasite of the Amaanthus stem weevil in South India.

(7) *Microbracon hebetor* as a parasite of *Dichomeris ianthe* on lucerne—Read before the Entomological society of India, South Indian Branch, Coimbatore.

(8) "Life History Notes on *Grammodes stolida*—A pest of Daincha (*Sesbania bispinosa*)—Read before the Entomological Society of India, South Indian Branch, Coimbatore.

(9) "Bee-keeping in Madras"—A popular article for publication in Indian Farming.

(10) "Bee-keeping as a Cottage Industry" for a Radio talk.

(11) "Some common vegetable pests and their control" and (12) "*Thevetia nerifolia*—A cheap contact insecticide" for publicat on in the Villagers, Calendar, 1943.

The first six papers were p esented before the Entomological section of the Indian Science Congress, January 1942.

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